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SECTION 1. ENGINEERING INNOVATION PROCESSES



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MULTIPARAMETRIC SEAWATER PROBE

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Аннотация. В статье рассматриваются разработка устройства для измерения параметров водной поверхности. Описывается разработанная структурная схема устройства, которое сможет измерять пять основных параметров морской воды (температуру, окислительновосстановительный потенциал, кислотность, соленость, мутность), составлять отчеты о произведенных измерениях и отправлять данные по радиоканалу GSM. Предложена недорогая компонентная база, в основе устройства предлагается использовать популярный и недорогой микроконтроллер ATMega328P.

Ключевые слова: измерения, зонд, экология, морская вода, микроконтроллер.

Annotation. The article discusses the development of a device for measuring the parameters of the water surface. The developed block diagram of the device is described, which will be able to measure the five main parameters of seawater (temperature, redox potential, acidity, salinity, turbidity), make reports on the measurements made and send data via GSM radio channel. An inexpensive component base is proposed, and the popular and inexpensive ATmega328P microcontroller is proposed to be used as the basis of the device.

Keywords: measurements, probe, ecology, sea water, microcontroller.

At the moment, tracking the parameters of seawater in coastal zones is an important task. This task is urgent, since there is a possibility of water pollution in these zones, as a result of which it is possible to disrupt the existing ecosystem.

In addition, there is a problem with the reservation of fresh water in Sevastopol, since the hillyterrain does not favor deep absorption of fresh water falling in the form

of precipitation. Most of it falls into the sea. The device under development will allow localizingplaces of intensive discharge of fresh water from land into the sea, as well as detecting underwatersources of fresh water.

Based on the analysis of seawater sensing devices, five main parameters of seawater were identified:

— acidity (pH);

— salinity;

— temperature

— turbidity;

— redox process (ORP).

Based on the measured data, it is possible to conclude about possible pollution of the coastal zone.

In accordance with the selected list of seawater parameters, a block diagram of the device was developed (Fig. 1).



Figure 1 – a block diagram of the device

The developed block diagram includes the following blocks: a microcontroller designed to process signals from sensors; a temperature meter necessary to obtain numerical values of the temperature of the sea water of the surface layer; a turbidity sensor designed to control the contamination of seawater with suspended particles; an acid meter necessary to obtain numerical values of pH and ORP; a salt measuring device to measure the amount of dissolved substances in the liquid under study; an indication module designed to configure the device and output the current values of the measured parameters; a real-time clock module designed for the correct operation of the GPS module, as well as for the possibility of recording the exact measurement time; an external Flash memory designed to save the measured values; a GPS module necessary to establish an accurate location; a module GSM, designed to send the received data over the radio channel.

As a microcontroller, it is proposed to take the ATmega328P as part of the Arduino Nano debugging board. As a temperature meter, there is a DS18B20 digital temperature sensor using a 1—Wire interface for data transmission, and having 4 measurement resolutions: 9, 10, 11 and 12 bits. As a turbidity sensor, it is proposed to use the TS-300B turbidimeter, which is a bundle of an infrared diode as a light source and a photoresistor as a light detector. The proposed acidity meter — the FLASH-I2C liquid acidity sensor, built on the basis of the STM32F030F4 microcontroller, the LMC7101 operational amplifier, is equipped with an I2C interface. As an indication module, it is proposed to use the LCD Keypad Shield LCD display. The proposed model of the external Flash memory module is Micro SD Storage Board.

To solve the problem of obtaining coordinates and transmitting data on water parameters, it is proposed to use a multifunctional device Wio Tracker, which combines GPS, GSM and Bluetooth 3.0 modules.

Thanks to the use of the GPS module, it is possible to link to the terrain, which allows you to build a map showing the change of the variable parameters in space.

As a result of the work carried out, a block diagram of the device was developed, consisting of a number of sensors for measuring the main parameters of seawater. The developed device basically has a budget component base and satisfactory measurement accuracy.

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UDC 665-642 **PYROLYSIS OF PROPANE-BUTANE FRACTION USING A MATHEMATICAL MODEL TAKING INTO ACCOUNT PENTANE IMPURITIES**

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Аннотация.В данной статье рассматривается процесс пиролиза пропан-бутановой фракции. Сравниваются объемы производства этилена в России и мире на 2018 год. Дается краткая теоретическая справка о химизме, механизме процесса, а также о различных математических моделях пиролиза, сложностях И при их конструировании. Упоминается процесс коксообразования и факторы, которые на него влияют. Кроме того, в статье проанализированы две углеводородные смеси с учетом наличия пентана в составе при разных температурах с помощью детерминированной математической модели, построены графики по полученным данным и сформированы выводы.

Ключевые слова: пиролиз, углеводороды, пропан-бутан, пентан, коксообразование, кокс, математическое моделирование, модель, исследование

Annotation. This article discusses the pyrolysis process of the propanebutane fraction. The volumes of ethylene production in Russia and worldwide as of 2018 are compared. A brief theoretical background is given of the chemistry, the mechanism of the process, as well as of various mathematical models of pyrolysis, and the difficulties in their construction. The coke formation process and the factors that influence it are mentioned. In addition, the article analyzes the two hydrocarbon mixtures, taking into account the presence of pentane in the composition at different temperatures using a deterministic mathematical model, plots the obtained data and gives conclusions.

Keywords: pyrolysis, hydrocarbons, propane-butane, pentane, coke formation, coke, mathematical modeling, model, research

After reading the news, people are talking about chemicals, GMOseverywhere, and claiming that the integration of chemically engineered products into human society needs to stop. But if you look around, polymers play an important role in our lives: packaging, fabrics, disposable tableware, phones, headphones, and the list goes on for a very long time. PET, PVC, HDPE, polyethylene, polypropylene, polystyrene and other polymers are used everywhere. And no wonder that high demands are made on their quality. The quality of the final product depends on the quality of raw materials and the type of processing.

For example, pyrolysis is the thermal decomposition of hydrocarbons in the absence of oxygen. There are different types of pyrolysis: ethane, propane, butane, gasoline and gasoils, and the prevalence of this or that technology varies depending on the region. The main pyrolysis products are lower olefins, namely ethylene and propylene.

The volume of ethylene production in Russia in 2018 was 3 million tons. The largest volume of production is recorded in the Volga Federal District, and amounted to 2.2 million tons of the total annual amount [2, p. 8]; in addition, Russian producers are focused, mainly on the domestic market. And on the world market ethylene production exceeds 100 million tons, and the main suppliers are China and the USA.

The large-scale production volumes are caused by the equally largescale consumption of polymers in the world [2, p 8]. The volume of consumption of polyolefins represents more than 65% of the total demand for large-tonnage polymers, which exceeds 150 million tons per year. The main sales market is Asia, and then follows the U.S. and Europe.

Pyrolysis occurs under industrial conditions at a pressure close to atmospheric or higher and temperatures of 800 – 850 °C. The process is accompanied by many elementary reactions, which take place one after another. Therefore pyrolysis can be conditionally divided into two stages. At the first stage there is direct splitting of alkanes, it is characterized by heat absorption and, accordingly, by high temperatures, it is possible in two directions, breaking of C-C bond and C-H bond, but the second one is often neglected in practice, because it is thermodynamically unlikely. After that, further dehydrogenation, isomerization and condensation of formed products occur, which, on the contrary, is characterized by heat release and relatively low temperatures. In pyrolysis of saturated hydrocarbons, a radical-chain process by the Rice-Hertzfeld-Kosiakoff mechanism is observed, and it includes initiation, development and chain breaking. For example, pyrolysis of propane can be described by the following equations [1, p. 18]:

 $C_3H_8 \rightarrow C_2H_4 + CH_4$

 $C_3H_8 \rightarrow C_3H_6 + H_2$

 $2C_3H_8 \rightarrow C_2H_4 + C_2H_6 + CH_4$

Based on the scheme of transformations, a kinetic model followed by a mathematical model is made. Deterministic mathematical models are the most widely used in modeling of pyrolysis processes. Because, unlike stochastic ones, they are based on a comprehensive approach, taking into account the physical and chemical nature of the process. Specifically, they allow taking into account a number of important parameters during calculations, such as coke formation rate, dependence of thickness of formed coke on specified parameters (pressure, temperature, contact time), composition of feedstock and its constancy, conditions of the process and stationarity. Modeling a chemical reactor also requires taking into account the phase state of reacting components and products, thermal conditions, frequency of loading and unloading of feedstock and products, the nature of movement of reaction flows within the reactor, and the structure of the reactor itself.

Therefore, there is no universal model suitable for all processes, because in large-scale calculations it is possible to encounter a number of problems. Firstly, a large volume of processed information is difficult in itself, since we cannot exclude the influence of human factor and a large number of errors can be made when entering data, when establishing relationships between components, when building a kinetic model, when determining the analytical method for solving the problem set, since by choosing the wrong strategy, we can only increase the volume of data. Secondly, comparison of theoretical and experimental data, for example, obtained from the operating production is not always feasible, because not all components in the initial mixture are recorded.

The analyzed propane-butane fraction, in general, does not have a constant composition. Different refineries have recorded different ratios of substances in the feedstock. Propane content varies up to 70 %, butane up to 90 % and pentane up to 10 %.

Using the model of propane-butane hydrocarbon fraction pyrolysis developed on the basis of the kinetic model proposed by Zhorov Yu.M., Vasilyeva N.I., Panchenkov G.M. [3] have analyzed two hydrocarbon mixtures of similar composition at 1.7 wt. % and 8.2 wt. % pentane as an impurity, 1.1 sec contact time and two temperatures: 825 °C and 850 °C. The data are presented in Table 1.

$$\begin{split} & C_2H_6\left(1\right) \to 0.47C_2H_4\left(2\right) + 0.53CH_4\left(3\right) \\ & C_3H_8\left(4\right) \to 0.32C_2H_4 + 0.34C_2H_6 + 0.16C_3H_6\left(5\right) + 0.18CH_4 \\ & C_4H_{10}\left(6\right) \to 0.10C_4H_6\left(7\right) + 0.32C_2H_4 + 0.27C_3H_6 + 0.15C_2H_6 + \\ & 0.16CH_4 \\ & C_5H_{12}\left(8\right) \to 0.16C_3H_6 + 0.37C_2H_6 + 0.35C_2H_4 + 0.12CH_4 \\ & C_2H_4 \to 0.15C_2H_2\left(9\right) + 0.85H_2\left(10\right) \\ & C_2H_4 \to polymers\left(11\right) \\ & C_3H_6 \to polymers \\ & polymers \to coke\left(12\right) \end{split}$$

The model can be called simplified, as it consists of only 8 reactions involving 12 components, but nevertheless it fulfills its functions to the fullest extent and allows to calculate the change in concentrations of the given components under certain thermodynamic conditions.

The system of derived differential and exponential equations based on the kinetic model and the law of acting masses is solved by the Runge-Kutta method, due to the fact that it has a much higher calculation accuracy, for example, compared with the Euler method, and is widely applicable for solving differential equations in chemical technology.

	Mixture	Composition of hydrocarbon mixture, % wt.							
	No.	Methane	Ethane	Ethylene	Propane	Propylene	Butane	Butadiene	Pentane
	1	2.3	3.6	3.8	56.5	3.6	25.7	2.8	1.7
	2	2.3	2.7	3.2	48.4	4.2	28.2	2.8	8.2

Table 1. Composition of raw materials for the mathematical model

The following conclusions can be drawn from the data in Figure 1:

1) The amount of pentane in the mixture remains almost constant throughout the process; it is consumed in very small quantities;

2) With the increase of the amount of pentane in the mixture from 1.7 % up to 8.2 % wt., the yield of ethylene increases;

3) No change in butane and propane curves, both the graphs show a decrease in quantity, with propane consumed faster and exponentially and butane more linearly;

4) The yield of ethane and propylene is only slightly affected by the change in pentane.





Comparing the data of Figure 1 and Figure 2, it can be said that our model works efficiently at 825 °C, and at 850 °C the output parameters of the target products change slightly, except for ethylene, which reaches its maximum later at 0.1 sec. It can also be observed that at 850 °C the propane and butane are consumed faster and the rate of product formation does not increase. Thus, increasing the load on the reactor is impractical.



Figure 2. Changing concentrations of components during pyrolysis at 850 °C: a – mixture 1; b – mixture 2.

Pyrolysis is complicated by the fact that during the process coke accumulates on the inner walls of the coils. To date, researchers argue that there are two main ways of coke formation: carbide cycle and consecutive [1, p. 25]. According to the consequent scheme, because of the presence of olefins and cyclic unsaturated hydrocarbons, which are subjected to irregular condensation, polycondensation and dehydropolycondensation reactions, flat structures of carbon atoms are formed. If we consider the carbide cycle, then in this case the formation of coke is due to the decomposition of hydrocarbons on the inner surface of the reactor, and such deposits are commonly referred to as carbonaceous deposits.

Different ways of formation also contribute to different composition of coke deposits. It can be represented as high molecular weight compounds in the form of resins, carbides, asphaltenes, and in the form of elemental carbon and hydrogen according to some scientists.

In addition, the accumulation of coke has a cumulative effect, since it takes much less energy to migrate the particles across the surface than to transit to the gaseous state. Therefore, spherical coke particles enter into compaction reactions at active centers, reaching impressive deposit sizes with a large molecular weight. The uniformity of coke distribution over the area of the coils depends on the process conditions, temperature and pressure, as well as on the composition of the feedstock and the residence time of the reaction mixture in the reactor.

Accumulation of coke leads to longer contact time, reduced output of target products, tougher conditions, which in turn accelerates coke formation. Coke accumulation, in addition, can lead to burnouts and create emergency situations, due to the fact that coke deposits create a thermal barrier effect, deteriorate the quality of the material of which the coils are made. All this contributes to an increase in energy costs of production against the background of reduced productivity of the furnace.

Figure 3 shows the dependence of the coke layer on composition and temperature. At 850 °C the rate of coke formation increased almost 2 times, with almost unchanged concentrations of target products at the outlet, as

mentioned above, which once again proves the ineffectiveness of increasing the temperature within our model. Also in the graph we can see that the presence of pentane admixture in the initial mixture affects the process of coke formation in the furnace poorly. Therefore, if possible, the percentage of pentane in the propane-butane fraction is tried to minimize or reduce to zero.



Figure 3. Change of coke layer thickness depending on the content of pentane in the composition at different temperatures

In conclusion, we can say that the pyrolysis process, as well as its mathematical modeling are quite complex and require increased attention. For modeling it is necessary to take into account hydrodynamics, chemical kinetics, as well as heat and mass transfer during the process. In addition, the calculations should take into account the process of coke deposition on the inner walls of the coils, which affects the heat transfer and pressure drop in the pipes. In the industry, different methods are used to clean the surface from coke, for example, coking inhibitors are introduced into the raw flow, pipes with a special coating that does not contain iron are used, abrasive particles are fed together with the flow of initial reagents. All methods have their disadvantages: difficulty in operation, high cost or low efficiency, so research in the field of prevention and/or minimization of coking is still relevant.

Modeling is complicated by a large number of input data, for example, there are models with more than 300 reactions involving more than 150 components, so the model considered in this article can be called concise. As for the research, we considered the ideal displacement reactor with distributed parameters, as the parameters varied in time and along the length of the apparatus. It was shown experimentally that the optimum temperature regime should be observed in the order of 825 °C and minimize the amount of pentane impurities in the propane-butane fraction, as at increase in temperature to 850 °C and pentane content to 8.2 % wt. the thickness of coke deposits increased almost twice, in comparison with the first mixture at temperature 825 °C.

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BREAKING INTO ACTIVE DIRECTORY ENVIRONMENTS

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Аннотация. Эта статья представляет собой всеобъемлющий обзор Active Directory. В нем рассматриваются безопасности распространенные уязвимости и тактики, которые киберпреступники используют для проникновения в ИТ, предлагаются методы его защиты и подчеркивается важность обнаружения и реагирования на инциденты. В нем также содержатся советы по профилактике и информация об инновациях в защитных технологиях, нулевом доверии и повышенном внимании к обнаружению и реагированию. Следуя рекомендуемым передовым методам и руководящим принципам, организации могут снизить риски нарушений кибербезопасности, сохранить конфиденциальные данные в безопасности и обеспечить непрерывность компаний.

Ключевые слова: безопасность Active Directory, Угрозы кибербезопасности, Реагирование на инциденты, Советы по предотвращению, Уязвимости.

Annotation. This article is a comprehensive overview of Active Directory security. It covers the common vulnerabilities and tactics that cybercriminals use to penetrate it, offers techniques to protect it, and emphasizes the importance of detection and incident response. It also provides prevention tips and insights into innovations in defensive technologies, zero trust, and increased focus on detection and response. By following the recommended best practices and guidelines, organizations can reduce the risks of cybersecurity breaches, keep sensitive data safe, and ensure business continuity.

Keywords: Active Directory Security, Cybersecurity Threats, Incident Response, Prevention Tips, Vulnerabilities.

I. Introduction

Active Directory (AD) is a Microsoft technology that provides a centralized way of managing and organizing resources for computers and users on a network. It is a database repository for domain and network resource information, and it helps organizations manage users, computers, and applications. AD is a critical component of the IT infrastructure of many businesses, enabling centralized management of network resources, authentication and authorization of users, and user and group policy management.

II. Understanding Active Directory Vulnerabilities

Active Directory (AD) is a widely used technology that provides a central location for storing and managing computer and user object data. However, it is also the target of many cyberattacks due to its critical role in most organizations. Weak passwords, outdated software and patches, inadequate auditing and monitoring of AD events, exposure of sensitive information, and misconfigured permissions are some common security vulnerabilities in Active Directory.

Attackers use different methods to exploit these vulnerabilities in AD, such as password guessing, social engineering, malware, file-less attacks, and exploiting remote code execution vulnerabilities. Compromised accounts of legitimate users can also provide attackers with legitimate access to the AD environment.

Security breaches in Active Directory environments can have severe consequences for organizations, ranging from theft of data, disruption of operations or services, data tampering or destruction, reputational damage, and legal implications that can result in financial penalties and lawsuits. It is essential to regularly conduct security assessments, patch vulnerabilities, conduct threat modeling, and harden the AD environment to mitigate the risk of cyberattacks.

III. The Tools and Tactics Used to Penetrate Active Directory

Attackers use various tools and techniques to compromise AD environments, including reconnaissance, brute force attacks, spear phishing, social engineering, malware, and exploits. Reconnaissance is the process of gathering information about the AD environment, such as the domain name, IP addresses, user accounts, security policies, and other available resources. Attackers use this information to target specific attacks and increase their chances of success. Information leakage through platform misconfigurations and user errors can also provide attackers with useful reconnaissance measures to determine ideal points of access.

Brute force attacks are automated attacks that try many different password combinations until a valid account password is obtained. This type of attack is especially effective for weak passwords, as they are easily guessed by automated brute force tools.

Spear phishing is a targeted email or message attack that designs specifically to deceive an individual into performing an action, such as clicking on a malicious link or entering their AD credentials. Attackers often launch spear phishing attacks as a precursor to launching more complex attacks; once an attacker gains a foothold in the AD environment, they can move laterally to other machines, escalating the level of access privileges each time.

Social engineering is a technique attackers use to manipulate and deceive their targets into performing actions that grant them access they cannot obtain on their own. For example, social engineers may create a fake software update to prompt a user to provide their credentials or trick them into granting access to systems they shouldn't.

Malware and exploits are malicious code snippets that attackers use to exploit vulnerabilities in AD environments. Once an attacker gains access through a malware or exploit, their objectives can vary from stealing sensitive data to establishing a foothold on the network. Attackers can use malware to gather sensitive data and exfiltrate it or to create a 'backdoor' that they can use to access the environment in the future.

IV. Techniques to Protect Active Directory

To prevent such an attack, businesses need to adopt strong security measures to protect their AD environments. One of the most crucial techniques is hardening AD security by implementing the best security practices. This can involve reducing the number of domain administrators, auditing user permissions, enforcing password policies, and disabling unnecessary services.

AD environments should be also kept up to date to ensure security. This is where ongoing security monitoring plays a critical role. Monitoring enables businesses to identify attempted attacks and vulnerabilities, allowing them to take immediate countermeasures to ensure that the environment is safe and secure from attackers. Another important step in AD security is network segregation. Network segregation involves separating different parts of the AD environment and applying different security measures based on the risk profile of each network component.

Access controls are another vital component of AD security, allowing an organization to specify precisely who can access which parts of the AD environment. This can include user accounts, groups, and objects, managing each user's access rights to different sections of the environment.Businesses must also ensure that they maintain their AD environment regularly. This involves regular patching of systems, software updates, and conducting vulnerability scans frequently to mitigate the risk of cyberattacks.

V. Detection and Incident Response

One key way to detect incidents in Active Directory environments is to set up auditing, which enables capturing all activities in the environment, including changes made to Active Directory objects and permissions. Organizations can also establish a baseline that captures normal activity levels in the environment for easy identification of deviations from the baseline. Additionally, actively monitoring activity, particularly for signs of malicious activity, like invalid login attempts, can help uncover and address potential incidents.

Incident response plans are crucial components of a solid cybersecurity strategy. Incident response plans provide guidance on the essential steps to take in the event of an incident in Active Directory environments. Such plans should include incident classification, assessment, containment, communication, remediation, and post-incident reviews.

Incident classification involves clearly defining the severity, impact, and priority of the incident to enable initiation of appropriate action by the response team. Once the incident is identified and contained, stakeholders must be kept informed of the situation and progress towards resolution. Remediation involves fixing issues identified during assessment and containment, preventing any further damage. Finally, organizations should carry out post-incident reviews, which enable learning and improvement of processes to enhance incident response plans, create awareness of potential issues, and prevent future incidents.

VI. Prevention Tips

Preventing cybersecurity breaches is an essential aspect of ensuring the security of organizational data. Implementing effective prevention strategies can help minimize the likelihood of data breaches, which can be costly and potentially devastating. Three key preventive strategies include employee training, implementing security measures, and applying the principle of least privilege.

Providing regular cybersecurity awareness training to employees is an effective way to prevent data breaches. Such training can help employees recognize phishing scams, social engineering tactics, and other types of cyber-attacks. By familiarizing employees with proper cybersecurity measures, organizations can reduce the risks of accidental breaches caused by these types of attacks.

Another important preventive strategy is implementing robust security measures. A strong multi-layered security approach is key, which can involve antivirus software, intrusion detection and prevention systems, firewalls, and other security solutions. Encryption of sensitive data can help protect it from unauthorized access, and frequent software updates can address known vulnerabilities in software systems.

VII. Conclusion

Active Directory security is crucial for maintaining the safety of organizational data and ensuring business continuity. With the increasing complexity and interconnectedness of these environments comes a growing number of cybersecurity threats. A proactive approach to detecting and addressing vulnerabilities is key, starting with Active Directory auditing, monitoring activity for malicious activity, and having a well-defined incident response plan.

Prevention is also critical, including employee training, implementing security measures like firewalls and antivirus software, and using the principle of least privilege to limit user access rights. Continual learning and improvement are essential to stay on top of cybersecurity threats and maintain effective security protocols.

In summary, ensuring Active Directory security involves maintaining a proactive approach that includes cyber incident detection and incident response, prevention measures such as employee education, secure software, and access controls, as well as a commitment to continual improvement. By following these critical best practices and guidelines, organizations can reduce the risks of cybersecurity breaches, keep sensitive data safe, and continue to uphold their business operations as intended.

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NETWORK SIMULATION IN DIGITAL FORENSICS

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Аннотация. В этой статье рассматривается важность И применение инструментов сетевого моделирования в цифровых криминалистических В определяются расследованиях. нем инструменты сетевого моделирования, их типы И примеры программного обеспечения. В нем также рассматриваются преимущества и успешные примеры их использования, факторы, которые следует учитывать при выборе инструментов сетевого моделирования, и альтернативные инструменты, которые следует рассмотреть.

Ключевые слова: инструменты сетевого моделирования, Цифровая криминалистика, Расследования, Безопасность, программное обеспечение.

Annotation. This article covers the importance and application of network simulation tools in digital forensics investigations. It defines network simulation tools, their types, and software examples. It also explores the benefits and successful cases of their use, factors to consider when selecting network simulation tools, and alternative tools to consider.

Keywords: network Simulation Tools, Digital Forensics, Investigations, Security, Software.

I. Introduction

In today's digital age, network simulation tools have become invaluable tools for digital forensics investigators. A network simulation tool is a software application that allows users to replicate a network environment virtually. It allows users to create a working model of a real or hypothetical network, which helps investigators understand how a network works, how it was compromised, and how it can be fixed. The importance of network simulation tools in digital forensics cannot be overlooked. They have proven to be useful in various digital forensic investigations as they provide a safe and secure environment to test network security measures, identify security breaches, and carry out forensic investigations. As such, this article explores the significance of network simulation tools in digital forensics, and how they can be applied to enhance digital forensic investigations [3].

II. What are network simulation tools?

At its core, network simulation tools are software applications that enables users to replicate a virtual network environment. These tools provide a safe and secure environment to test network security measures, identify security breaches, and carry out forensic investigations. There are different types of network simulation tools available in the market, and they all come with different features and functionalities. Some of the types of network simulation tools include hardware simulators, network emulators, and packet generators. These tools simulate different aspects of a network environment and allow users to configure and control network parameters such as bandwidth, latency, packet loss, and network topology. Some examples of network simulation tools used in digital forensics investigations include INetSim, GNS3, F5 Networks VLab, and SolarWinds Network Device Simulator. These software/tools are widely used by digital forensics experts to create virtual environments that replicate real-world network scenarios to enhance the effectiveness and accuracy of their investigations.

III. How are network simulation tools used in digital forensics?

Network simulation tools are widely used in digital forensics investigations as they provide a safe and controlled environment for investigators to test different network scenarios. These tools are applied in digital forensics to simulate a network environment, create network topologies, inject traffic, and to create digital artifacts that can help investigators analyze network traffic, detect network attacks, and hand over evidence to the law. There are several benefits associated with using network simulation tools in digital forensics investigations including their ability to create a realistic network environment, to test & verify network configurations, to identify network vulnerabilities, and to optimize network performance [4].

There have been many cases where network simulation tools have been used in successful digital forensics investigations. One such example is the Stuxnet malware investigation where network simulation tools were used to recreate the victim's network environment, determine the malware's origin, and identify the security vulnerabilities that were exploited. The investigation led to the discovery of the malware's authors and provided valuable insights into how cybercriminals use advanced techniques to get into network environments. Furthermore, network simulation tools have also been used to simulate attacks on networks to test their level of security and determine their response to attacks [2].

IV. Selecting the right network simulation tool

Selecting the appropriate network simulation tool for digital forensics is critical for investigators to conduct effective investigations. Choosing the right tool can depend on several considerations such as cost, technical expertise, functionality, and features.

When choosing network simulation tools, investigators should consider factors that include the software's features, how easy it is to use, and how much it costs. Additionally, the compatibility of the tool with the hardware and software of the investigator's network environment should also be considered. Before selecting a network simulation tool, it's crucial to compare different tools in the market by analyzing their features, functionality, and pricing. Comparing different features and functions can help find a tool that matches the investigator's specific needs. Investigators also need to ensure that the tool complies with industry standards, is scalable, and has a proven track record in the digital forensic field. Several factors impact the selection of network simulation tools for digital forensics investigations. These factors include the purpose of the investigation, compatibility with the network environment, type of network topology being tested, and the features that the tool possesses [1].

Choosing the right network simulation tool for digital forensics is essential to determine the effectiveness and accuracy of investigations. Investigators should consider factors such as the cost, technical expertise, functionality, and features. Comparison of features and functions of different network simulation tools in the market and other factors that impact tool selection should also be considered. By considering these critical factors, investigators can choose the right network simulation tool that meets their specific needs for successful digital forensic investigations.

V. Challenges and limitations associated with network simulation tools in digital forensics

One common challenge when using network simulation tools in digital forensic investigations is the difficulty involved in recreating a complete and accurate representation of the victim's network environment. This can be a critical issue in larger networks where capturing or replicating a full-scale network environment could be challenging. Another challenge is that the interpretation of the results from network simulations can also require a high degree of technical expertise, and inadequate interpretation can lead to incorrect results.Another limitation of network simulation tools in digital forensics is that they may not be practical or may be prohibitively expensive for some cybercrime cases. Some instances may require virtual machine environments rather than network simulations, or even require physical networks in some cases.

Alternative tools to network simulation when conducting forensic investigations include live test networks or physical networks. These alternative tools provide a more realistic and accurate representation of the victim's network environment. However, they may have downsides such as the need for additional hardware or maintenance, ultimately increasing the overall cost of the investigation.

While network simulation tools are useful for digital forensics investigations, they come with certain challenges and limitations. Investigators must understand the limitations and evaluate the suitability of such tools for each investigation. Additionally, it is essential to consider alternatives such as live test networks or physical networks when conducting forensic investigations to ensure accurate and reliable results.

VI. Conclusion

In conclusion, this article has explored the importance of network simulation tools in digital forensics and how they can be used to enhance investigations. It has provided an overview of what network simulation tools are, their types, and how they are applied in digital forensic investigations.

The usefulness of network simulation tools in digital forensic investigations has been emphasized throughout this article. Network simulation tools provide a safe and secure environment for investigators to test and verify network configurations, detect network attacks, and carry out forensic investigations. These tools replicate a network environment virtually, making it easier for investigators to understand how network operates, where it was compromised, and how to fix any vulnerability identified. While network simulation tools are essential, investigators need to consider certain challenges and limitations that come with their use. For instance, recreating an accurate representation of a victim's network environment may be challenging in larger networks. Additionally, the interpretation of results from network simulations requires a high degree of technical expertise, which may affect the quality of findings of investigations.

It is essential for investigators to evaluate network simulation tools suitability on a per-case basis, and they should consider factors such as cost, technical expertise, functionality, and features before selecting a tool. Moreover, investigating alternative tools, such as live test networks or physical networks, can provide a more realistic and accurate representation of the victim's network environment.

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UDC 53.08

SDR AND WHY DO WE NEED IT

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Аннотация.В статье рассматривается, как определить источник управляющего сигнала с помощью SDR (Software-Defined Radio). Для использовать анализатор спектра, который этого вам нужно представляет позволяющий собой инструмент, анализировать частотный спектр радиочастотного сигнала. С его помощью можно определить не только частоту сигнала, но и его мощность, ширину спектра и другие параметры. Для определения источника сигнала нужно использовать SDR в режиме сканирования. SDR будет сканировать частотный диапазон и искать сигналы, соответствующие параметрам управляющего сигнала. Как только сигнал обнаружен, вы можете проанализировать его параметры и определить источник.Важно отметить, что это предварительная аннотация, и для полного понимания темы могут потребоваться дальнейшие исследования.

Ключевые слова: SDR (программно-управляемое радио), спектральный анализатор, радиочастотный сигнал, частотный спектр, обнаружение источника сигнала, режим сканирования, параметры сигнала

Annotation. The article discusses how to determine the source of a control signal using SDR (Software-Defined Radio). To do this, you need to use a spectrum analyzer, which is a tool that allows you to analyze the frequency spectrum of a radio frequency signal. With its help, you can determine not only the frequency of the signal, but also its power, spectrum width, and other parameters. To determine the source of the signal, you need to use SDR in scanning mode. SDR will scan the frequency range and look for signals that match the parameters of the control signal. Once the signal is detected, you can analyze its parameters and determine the source. It is important to note that this is a preliminary annotation and further research may be necessary to fully understand the topic.

Keywords: SDR (Software-Defined Radio), spectral Analyzer, radiofrequency signal, frequency spectrum, signal source detection, scanning mode, signal parameters

Software Defined Radio (SDR) is a radio communication system where traditional hardware components of a radio, such as mixers, filters, amplifiers, and modulators, are replaced with software[1]. This allows for a

more flexible and customizable approach to radio communication, as well as the ability to use a single hardware device for multiple purposes. SDR technology has become increasingly popular in recent years, particularly in fields such as telecommunications, military and defense, and amateur radio.

One of the key advantages of SDR technology is its ability to adapt to changing communication needs. Unlike traditional radio communication systems, SDR can be easily reprogrammed with new software to support different communication protocols or frequency bands. This makes it a valuable tool for organizations that need to quickly adapt to changing communication requirements.

SDR technology has found use in a wide range of applications, including military and defense, telecommunications, and amateur radio. In the military and defense sector, SDR is used to improve communication between different units and branches of the military, as well as to support intelligence gathering and surveillance operations. In the telecommunications sector, SDR is used to provide more reliable and efficient communication services, while in the amateur radio community, SDR is used to experiment with new communication techniques and protocols [2].

Overall, SDR technology has revolutionized the way radio communication systems work by replacing traditional hardware components with software, enabling a more flexible and customizable approach to radio communication, and providing a highly valuable tool for organizations that need to quickly adapt to changing communication requirements.

There are many SDR devices available on the market, each with their own set of features, capabilities, and price points. Some popular SDR devices include the RTL-SDR, HackRF One, and USRP, but there are many more to choose from depending on your specific needs.

The RTL-SDR is a low-cost, entry-level SDR device that is popular among hobbyists and enthusiasts. It is based on the RTL2832U [2] chipset and can receive a wide range of frequencies, from 24 MHz to 1.7 GHz. The device is compact and portable, making it a great option for those who want to experiment with SDR technology without investing a lot of money.

The HackRF One is a more advanced SDR device that offers a wider range of features and capabilities. It is a software-defined radio platform that can transmit and receive signals in the frequency range of 1 MHz to 6 GHz. The device is highly programmable and can be used for a variety of applications, from penetration testing and security research to amateur radio and signal analysis [1].

The USRP is a high-performance SDR device that is often used in professional and academic settings. It offers a wide frequency range, from DC to 6 GHz, and can be customized with different daughterboards to support different applications. The device is highly programmable and can be used

with a variety of software packages, making it a versatile option for a range of applications.

When choosing an SDR device, it is important to consider your specific needs and use case. Factors to consider include frequency range, sensitivity, bandwidth, cost, and level of programmability. With so many options available, it can be difficult to choose the right device, but by carefully evaluating your needs and doing your research, you can find the SDR device that is right for you.

The article discusses how to determine the source of a control signal using SDR (Software-Defined Radio). By analyzing the frequency spectrum of a radio frequency signal with a spectrum analyzer, you can determine the frequency, power, spectrum width, and other parameters of the signal. SDR in scanning mode can then be used to look for signals that match the parameters of the control signal and determine its source.

SDR is an important tool for radio frequency analysis and can be used in a variety of applications, including radio broadcasting, wireless communication, and military intelligence. The ability to analyze and decode radio signals is crucial for identifying and mitigating potential threats, as well as for researching and understanding the behavior of radio systems.

It is important to note that while this article provides a preliminary annotation on the topic, further research may be necessary to fully understand the capabilities and limitations of SDR.

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DRONES. THE ACTUAL USING OF UAV

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3rd year student, Information Systems Departments, Sevastopol State University, e-mail: azarov@ieee.org Andrey Azarov Scientific advisor, Post graduate student, Electron Engineering Department, Sevastopol State University e-mail: andrej-azarov@bk.ru Аннотация.В статье рассматривается все более широкое использование беспилотных летательных аппаратов (БПЛА или дронов) в точном земледелии. В статье освещаются потенциальные преимущества использования дронов в сельском хозяйстве, в том числе повышение эффективности, повышение урожайности и снижение воздействия на окружающую среду. В статье также обсуждаются некоторые проблемы, связанные с использованием дронов в сельском хозяйстве, такие как нормативные препятствия и необходимость специализированного обучения. В целом, в статье подчеркивается важность продолжения исследований и разработок в области точного земледелия, а также возможность того, что дроны будут играть важную роль в сельском хозяйстве будущего.

Ключевые слова: БПЛА, дроны, точное земледелие, повышение эффективности, повышение эффективности, снижение воздействия на окружающую среду

Annotation. The article discusses the increasing use of unmanned aerial vehicles (UAVs or drones) in precision agriculture. The article highlights the potential benefits of using drones in agriculture, including increased efficiency, improved crop yields, and reduced environmental impact. The article also discusses some of the challenges associated with using drones in agriculture, such as regulatory hurdles and the need for specialized training. Overall, the article emphasizes the importance of continued research and development in the field of precision agriculture and the potential for drones to play a major role in the future of farming.

Keywords: UAVs, drones, precision agriculture, increased efficiency, increased efficiency, reduced environmental impact.

The article highlights the potential benefits of using drones in agriculture, including increased efficiency, improved crop yields, and reduced environmental impact. The article also discusses some of the challenges associated with using drones in agriculture, such as regulatory hurdles and the need for specialized training. Overall, the article emphasizes the importance of continued research and development in the field of precision agriculture and the potential for drones to play a major role in the future of farming.

Drones and UAVs (Unmanned Aerial Vehicles) are aircraft that are remotely piloted or controlled autonomously [1]. They are often equipped with cameras or sensors and can perform a wide range of tasks, from surveillance and reconnaissance to package delivery and agricultural monitoring. In precision agriculture, drones can be used to gather data on crop health, soil moisture, and other environmental factors, allowing farmers to make more informed decisions about their crops. There are many types of drones, each with its own set of features and capabilities. Here are some examples:

• Quadcopters: These drones have four rotors and are popular for recreational use and aerial photography/videography.

• Fixed-wing drones: These drones have wings like a traditional airplane and are more efficient than quadcopters for covering large areas.

• Single-rotor drones: These drones have one rotor and are often used in industrial and military applications.

• Hybrid drones: These are a combination of fixed-wing and quadcopter drones, offering the best of both worlds in terms of speed and maneuverability.

• Nano drones: These are the smallest type of drone, often used for indoor flying and racing.

These are just a few examples, and the types of drones available continue to grow and evolve as technology advances. Drones are used for a variety of purposes, such as:

1. Aerial photography and videography: Drones equipped with highquality cameras are used to capture stunning aerial footage in movies, documentaries, and sports events.

2. Agriculture: Drones with specialized sensors are used to capture data on crop health, soil moisture, and other environmental factors to help farmers optimize their crop yields and reduce their use of pesticides and fertilizers.

3. Search and rescue operations: Drones equipped with thermal cameras and other sensors are used to locate missing persons, detect fires and other disasters, and provide real-time intelligence to rescue teams.

4. Law enforcement: Drones are increasingly being used by police and other law enforcement agencies for surveillance, crowd control, and traffic monitoring.

5. Delivery and logistics: Drones are being developed for use in package delivery and other logistics applications, allowing for faster and more efficient delivery of goods over long distances.

6. Military and defense: Drones have become an important tool for military operations, providing real-time intelligence, surveillance, and reconnaissance capabilities without putting human pilots at risk.

Alsodrones have evolved into more complex machines with better technology and improved capabilities. Nowadays, drones can be equipped with a range of sensors, communication devices, and other hardware that make them suitable for even more sophisticated tasks.

For example, some drones are equipped with artificial intelligence that allows them to make autonomous decisions based on data from their sensors. These machines can be programmed to perform tasks such as inspecting infrastructure, building and construction, and even flying in swarms or following preset paths. They can also carry out complex mapping and 3D modeling tasks, which makes them useful for surveying and construction.

Moreover, some drones can be used to monitor the environment and detect any changes in it. They can help track wildlife, study the ocean and the atmosphere, and identify areas that need protection from natural disasters, pollution, and other threats.

Overall, drones have become an increasingly versatile and valuable tool with a wide range of applications that have yet to be explored fully. They continue to revolutionize various industries and enhance human productivity in many ways.

In conclusion, drones or unmanned aerial vehicles (UAVs) have come a long way and their usage has evolved from being a mere military surveillance tool to becoming an important asset for several industries. With advancements in technology, drones are equipped with better sensors, artificial intelligence, and communication devices, thereby making them capable of performing more complex and sophisticated functions. From aerial photography and videography to agriculture, search and rescue, logistics, and defense, drones are being utilized for a wide range of tasks. These unmanned vehicles have proved to be an efficient, cost-effective, and safe alternative to traditional methods of data collection and surveillance. The usage of drones is expected to keep growing in the future, as they are set to become an integral part of various industrial sectors.

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CYBRID TYPE OF DRONES. WHY DO WE NEED IT

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Аннотация.В статье рассматривается появление гибридных дронов, которые сочетают в себе черты беспилотных и мультироторных В статье подчеркиваются значительные преимущества дронов. использования этих дронов в широком спектре приложений, таких как съемка. картографирование, исследование ликой природы И логистика.В статье объясняется, как гибридные дроны обеспечивают увеличенное время полета и возможности быстрого взлета и посадки, позволяя дрону зависать на месте в критические моменты. Эта функция делает дроны Hybrid идеальными для съемки больших участков земли и получения высококачественных изображений и данных, которые используются в различных отраслях.В аннотации также обсуждаются технические особенности использования гибридных дронов, таких как моторизованный сервопривод, который наклоняет несущие винты для взлета и посадки, и убирающееся шасси для четкого обзора камеры. Кроме того, в статье исследуются перспективы гибридных дронов в будущем, такие как их все более широкое распространение в различных секторах и их доступность по мере совершенствования технологий.В заключение в статье показано, как гибридные дроны формируют индустрию дронов и обеспечивают многочисленные преимушества по сравнению с традиционными мультироторными дронами. В целом в аннотации удачно подчеркнуты преимущества гибридных дронов и их значение для улучшения работы в различных областях.

Ключевые слова: Гибридные дроны, дроны с неподвижным крылом, мультироторные дроны, VTOL (вертикальный взлет и посадка), увеличенное время полета, поворотный механизм

Annotation. The article examines the emergence of hybrid drones, which combine the features of fixed-wing and multirotor drones. The article highlights the significant benefits of using these drones in a wide range of applications, such as surveying, mapping, wildlife research, and logistics. The article explains how hybrid drones offer extended flight times and rapid takeoff and landing capabilities while allowing the drone to hover in place during crucial moments. This feature makes Gybrid drones ideal for surveying large tracts of land and capturing high-quality images and data that are used for various industries. The annotation also discusses the technicalities of using hybrid drones, such as the motorized servo that tilts the rotors for takeoff and landing, and retractable landing gear for clear camera views. Besides, the article explores the prospects of gybrid drones in the future, such as being increasingly prevalent in various sectors and becoming more affordable as technology improves. In conclusion, the article demonstrates

how Gybrid drones are shaping the drone industry and providing numerous advantages over traditional multirotor drones. Overall, the annotation successfully highlights the benefits of hybrid drones and their significance for improving operations in various fields.

Keywords: Hybrid drones, fixed-wing drones, multirotor drones, VTOL (vertical takeoff and landing), extended flight times, tilt-rotor mechanism

The article highlights the emergence of a new type of drone, the hybrid drone or "cybrid drone." This type of drone combines the best features of both traditional fixed-wing drones and multirotor drones, offering extended flight times, rapid takeoff and landing, and the ability to hover in place.

The article explains the significance of Gybrid drones in various industries, such as surveying, mapping, and logistics. By combining the best of both worlds, Gybrid drones offer new possibilities for data acquisition and monitoring operations. Furthermore, the adoption of Gybrid drones allows industries to save time and money due to less battery downtime and higher performance efficiency.

In addition, the article addresses the technicalities of these drones, such as the motorized servo, which tilts the rotors for takeoff and landing, as well as the retractable landing gear. This feature enables the drone to take off and land in tight spaces and ensures clear camera views during flight, making it an efficient tool for capturing high-quality images and data.

A Gybrid drone, or hybrid type drone, consists of several components that allow it to combine the features of both fixed-wing and multirotor drones. Here are some of the key components of a Gybrid drone:

1. Rotors: A Gybrid drone typically has four or more rotors, which allow it to take off and land vertically, similar to a multirotor drone.

2. Fixed Wings: Fixed wings provide the lift and propulsion for horizontal flight, like a fixed-wing drone. These wings enable Gybrid drones to cover greater distances and fly for longer periods.

3. Tilt-Rotor Mechanism: Some Gybrid drones have a tilt-rotor mechanism that enables them to transition from vertical to horizontal flight. The rotors can tilt at an angle to switch between modes, providing greater flexibility in flight.

4. Retractable Landing Gear: In some Gybrid drones, the landing gear is retractable, allowing for an obstruction-free view of the onboard camera during flight.

5. Autopilot System: Gybrid drones often come equipped with an autopilot system that controls the drone's flight path, speed, altitude, and other parameters.

6. Power Source: A Gybrid drone's power source can include batteries, fuel cells, or hybrid systems, depending on the drone's design and application.

Overall, a Gybrid drone is a complex system that combines the key components of fixed-wing and multirotor drones, providing the operator with the flexibility to fly the drone and cover various distances and altitudes.

Gybrid, or hybrid type drones, are used in various industries for their extended flight times and flexible functionality. Here are some of the applications where Gybrid drones can be used:

1. Agriculture: Gybrid drones can be used in agriculture for crop monitoring, resource optimization, and yield estimation. These drones can capture aerial data of soil moisture levels, nutrient deficiencies, or crop damages, thereby enabling farmers to optimize crop yield and minimize losses.

2. Surveying and Mapping: Gybrid drones can be used by land surveyors and cartographers for accurate mapping and topographical data collection. These drones can cover a large area in a single flight, collecting data at high resolution.

3. Wildlife Monitoring: Gybrid drones can be used for wildlife monitoring in remote areas. For example, drones can collect data on migrating patterns or breeding habits, helping conservationists and researchers in monitoring and protecting endangered species.

4. Mining: Gybrid drones can also be used in the mining industry for environmental management and safety assessment purposes. These drones can monitor tailings dams, slope stability, and water quality, among other functions, reducing the risk of hazardous incidents.

5. Logistics: Gybrid drones can be used in logistics applications, such as package delivery and infrastructure inspection. These drones offer several benefits, such as speed, reach, and flexibility over traditional delivery methods.

Overall, Gybrid drones are versatile and offer unique solutions that enable various industries to optimize their operations and collect data efficiently. As such, they continue to gain popularity and have become increasingly prevalent in many sectors.

Gybrid, or hybrid type drones, refers to a type of drone that combines features of both fixed-wing and multirotor drones. These drones offer a unique combination of the vertical takeoff and landing (VTOL) capabilities of multirotor drones and the speed and endurance of fixed-wing drones.

In a Gybrid drone, the rotors of a multirotor drone are used for vertical takeoff and landing, while the fixed wings provide lift and propulsion during horizontal flight. This enables the drone to cover more distance with fewer batteries, allowing for longer flight times than multirotor drones.
Additionally, Gybrid drones can hover in place, which makes them a useful tool for capturing data with high precision.

The design of Gybrid drones varies depending on the specific purpose and application. Some Gybrid drones have tilt-rotor mechanisms and retractable landing gear, while others have modular designs, which allows the drone to be customized for various applications.

Overall, Gybrid drones offer several benefits over traditional drones, such as longer flight times, greater speed, and flexibility, making them ideal tools for various industries, including agriculture, surveying, and logistics.

The article concludes that Gybrid drones are an important technological advancement that offers a range of benefits over traditional drones, such as longer flight times, increased speed, and greater flexibility. The article notes that the integration of Gybrid drones can significantly improve operations and data collection techniques for many industries.

Furthermore, the article emphasizes the escalating relevance of Gybrid drones and their customizable features, including their tilt-rotor mechanism, retractable landing gear, and autopilot system. Finally, the article highlights the potential of Gybrid drones in the future, as technology continues to improve and the demand for efficient data collection and monitoring operations grows.

In conclusion, the article emphasizes the advantages of Gybrid drones and their capabilities, as well as their significance for improving operations and data collection for various fields. Gybrid drones have the potential to transform the drone industry, which opens the door to innovative solutions and opportunities for industries seeking to maximize productivity and reduce costs.

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UDC:621.3.049.77:681.3.06 DEVELOPMENT OF A VOICE CONTROL METHOD USING ELECTROMECHANICAL MODULES

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Аннотация.В данной статье был рассмотрен один из способов улучшения жилищных, офисных или складских помещений, посредством частичной автоматизации с использованиемкрепящегося на различные поверхностиустройства. Механизм изготовлен из недорогих материалов, а также имеет низкое энергопотребление. Для контроля и передачи потока информации была использована возможностьголосовогоуправлениядля выполнения команд на частичной автоматизацией. устройстве с Особенностьюданнойсистемыявляется отсутствием необходимости профильных знаний и существенных временных и финансовых затрат. В было разработано рамках статьи и протестировано экспериментальное устройство, демонстрирующее работоспособность эффективность предложенного метода. устройство способно распознавать и выполнять различные голосовые команды, такие как включение/выключение света, открытие/закрытие двери, регулировка температуры и т.д.

Ключевые слова: голосовое управление, частичная автоматизация, электромеханические модули, экспериментальное устройство энергосбережение

Annotation. This article examines one of the ways to improve residential, office or warehouse premises by means of partial automation using a device that can be attached to various surfaces. The mechanism is made of inexpensive materials and has low energy consumption. The possibility of voice control was used to control and transmit the information flow for executing commands on the device with partial automation. The feature of this system is the absence of the need for specialized knowledge and significant time and financial costs. Within the article, an experimental device was developed and tested, demonstrating the functionality and efficiency of the proposed method. The device is able to recognize and perform various voice commands, such as turning on/off the light, opening/closing the door, adjusting the temperature, etc. **Keywords:** voice control, partial automation, electromechanical modules, experimental device, energy saving

Introduction

Today, automation and electronics are an integral part of everyone's life. However, most home automation systems are designed in such a way that their implementation requires significant resources and special knowledge. The aim of the research is to develop a voice control algorithm using electromechanical modules that can be applied to various devices and systems. To solve this problem, we developed an electromechanical device based on the principles of the Internet of Things paradigm. Our device has a number of advantages over other home automation systems. First, it is made of inexpensive materials and has low energy consumption, which reduces the costs of its purchase and operation. Second, it is easily attached to various surfaces and does not require complex configuration or connection to the network, which facilitates its installation and use. Third, it supports the feature of voice control for executing commands on the device with partial automation, which improves the convenience and efficiency of interaction with electromechanical modules in various rooms [1].

Variations of interaction with the system

Three channels are provided for human interaction with a device: a voice channel using the Yandex "Alice" API, direct control via the Yandex "Home" mobile application, and physical control using the switch button, which allows you to adjust the light without using a device installed on the switch, and maintain the ability to control the light even if the device crashes. It should be taken into account that the voice control algorithm may not cope with complex or ambiguous commands or situations, and the testing environment may have some noise or interference that affects the quality of voice input or output.

The device communicates with Yandex servers using Message Queue Telemetry Transport (MQTT). This protocol has several advantages for solving the task assigned to the device, such as simplicity and speed of transmitting small data packets, as well as the possibility of encryption due to its structure (Figure 1). MQTT is an open-source protocol built upon TCP/IP, which allows transferring messages between different devices. MQTT uses a publish/subscribe architecture, in which clients do not communicate directly with each other, but through an intermediator called a broker. The broker filters incoming messages and distributes them to the appropriate subscribers. This architecture increases flexibility and reliability in IIoT (Industrial Internet of Things) applications, as it decouples publishers and subscribers, as well as allows storing messages for offline clients and delivering them when the resource is available. In addition, MQTT



Figure 1 – MQTT data exchange scheme Features in the device

In the device management system, some requirements were issued, such as low energy consumption, fault tolerance, access to the Internet using a wireless Wi-Fi interface and the presence of control ports for electromechanical devices. The Espressif Systems microcontroller of the ESP 32 model meets all the above criteria [2, 3]. This solution has competitive advantages such as low power consumption and high performance, which allows not only to communicate with external servers, but also to launch your own in the absence of Internet access.

For the safety of installing the device by a person without specialized education, it is necessary that there is no introduction into the electrical network of the house. Considering this, it is necessary to influence the light switches available in each house, which requires the use of electromechanical devices such as a servo motor [4]. This tool is ideally suited for use in the device due to the ability to accurately set and hold the rotation angle, which will guarantee the control of the wall light switch.

For ease of implementation of the device, a housing was developed an overlay (Figure 2) on the light switch, consisting of three main parts — a cover on the switch that allows you to easily attach the device to any home light switch, an electronics housing designed to mount microcontrollers and batteries, a color-off switch designed to press a key the switch.



Figure 2 – The housing of the device on the light switch **Conclusion**

The conclusions of the research were that the voice control algorithm using electromechanical modules was a feasible and effective technology for human-machine interaction. The algorithm contributed to the development of the field of voice control by providing a novel and versatile solution that can be adapted to different applications and domains. The algorithm also had practical value for improving the convenience, efficiency and safety of human-machine interaction. In the course of the work, a device was developed that allows the introduction of smart home systems without specialized knowledge and significant time and money costs.

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ARDUINO MICROCONTROLLER AND NEXTION DISPLAY INTERACTION

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Аннотация.Перед любым профессиональным и любительским разработчиком электронных средств рано или поздно встает проблема практической реализации своего проекта, его тестирования, отладки и настройки. Макетирование электронных средств на платформе Arduino неплохой способ решения проблем, но решает задачу лишь частично, ведь в данном случае смоделированная электроника нуждается в пользовательском графическом интерфейсе. В данной статье рассматривается взаимодействие микроконтроллера Arduino и дисплея Nextion, который является человеко-машинным интерфейсом с собственным процессором и памятью. С помощью этих устройств возможно создание макета электронного устройства с индивидуально настраиваемым графическим интерфейсом и визуализацией данных. Описаны принципы реализации графического интерфейса с помощью специального редактора NextionEditor, а также способы передачи данных между Arduino и дисплеем Nextion по различным портам. Приводятся примеры использования дисплея Nextion для отображения показаний с датчиков и для управления удаленными устройствами. Статья может быть полезна для разработчиков устройств на базе Arduino, которые хотят сделать свои проекты более современными и удобными для пользователя.

Ключевые слова: Arduino, Nextion, макетирование, интерфейс, электроника.

Annotation. Sooner or later, any professional or amateur electronic device developer faces the problem of practical implementation of his project, its testing, debugging and adjustment. Layout of electronic devices on the Arduino platform is not a bad way to solve the problem, but it solves the problem only partially, because in this case, the simulated electronics need a user graphical interface. This article deals with the interaction between the Arduino microcontroller and the Nextion display, which is a human-machine interface with its own processor and memory. With the help of these devices, it is possible to create a layout of an electronic device with a customizable graphical interface and data visualisation. The principles of implementing a graphical interface by means of Nextion Editor are described, as well as the methods of data transmission between Arduino and Nextion display via various ports. Examples are given of how to use the Nextion display to display sensor readings and control remote devices. The article may be useful for developers of Arduino-based devices who want to make their projects more modern and user-friendly.

Keywords: Arduino, Nextion, layout, interface, electronics.

The Arduino platform is a platform for building electronics with your own hands. The printed circuit board, which is a programmable microprocessor, can be connected to various components such as sensors, screens and switches, thanks to its large number of ports and busbars. It is also possible to connect other boards with their own functions, such as a flight controller for a drone or a Wi-Fi module. Arduino can be programmed using the free Arduino IDE software shell, which uses the C++ language with the Wiring framework [1]. The platform is suitable for novice users with a minimum entry threshold of knowledge in electronics development and programming. The capabilities of Arduino depend on the type of board, the connected components and the written program [2].

The appearance of the Arduino platform is shown in figure 1:



Fig. 1 — Arduino Diecimila microcontroller

Arduino Diecimila is a microcontroller board based on the ATmega168 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button[3]. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC adapter or battery to get started. A microcontroller is easy to learn and anyone can build their own device, a remote-controlled project or even a smart home system on it. But what about data visualisation? It requires a display, but any visualisation of data is a waste of microcontroller resources, memory and processing power. In addition, setting up the required interface can be very time-consuming for the untrained person. The solution to this problem is to use the Nextion range of displays or their counterparts.

The Nextion display is a display that is specifically tuned for Human-Machine Interface (HMI) and touch control of various remote devices. There is no platform separation for this display and it connects to any microcontroller that supports UART/Serial, allowing it to interface with most platforms.

The main feature of this display is that Nextion has its own microcontroller, clocked from 48MHz to 108MHz, which allows you to create a user-friendly, responsive graphical interface without consuming the power resources of the Arduino platform. Thus, all of the power consumption for creating the interface is transferred to the display itself, allowing more power-consuming programs to be used on the Arduino [4]. Additionally, the responsiveness of the device is increased because data streams are not sent from the display to the platform microcontroller and back again, but are processed locally.

Another addition is the ability to connect peripheral devices for more convenient use of the display. Or you can turn the display into a stand-alone peripheral device, which is what happens when you connect it to the Arduino. For this purpose, you have 8 I/O ports in the Nextion HMI display.

To exchange data between the external microcontroller and the display you can use special libraries such as SoftwareSerial, which is included in the standard Arduino IDE, to connect to the display via the UART software bus, or you can use a typical data acquisition code.

Construction of the interface for remote control is done mainly with the Nextion Editor. An intuitive editor can make a user-friendly interface in as little as an evening. The generated interface is stored in the internal flash memory of the screen, which can hold from 16 to 32 MB of data, depending on the model. This amount of memory not only allows you to make menus with multiple buttons, but also to add complex elements with frame-by-frame animations, page and background changes to get the right interface.

The Nextion display is an innovative solution for GUI development for various IoT applications. Nextion displays are touchscreens that support either resistive or capacitive (7.0") technology, which allow easy creation and editing of GUI using a special software - Nextion Editor. Nextion displays have different sizes - from 2.4" to 7", as well as different series - Basic. Enhanced and Intelligent. The Basic series offers the most economical and simple solution for HMI with minimal learning curve. The Enhanced series adds additional features, such as built-in EEPROM, RTC and 8 digital/binding GPIOs (4 of which can operate in PWM mode). The Intelligent series is the most advanced and powerful solution for HMI, which supports playing video, audio and animation, as well as moving and dragging components at runtime. The Nextion display has its own microcontroller, which processes all commands and data coming from an external microcontroller, such as Arduino. This allows to free up Arduino resources for more complex tasks and increase the responsiveness of the interface. The Nextion display connects to Arduino via the serial port UART/Serial using special libraries, such as SoftwareSerial. The Nextion display uses a simple text-based instruction set to control GUI and exchange data with Arduino. To create GUI on the Nextion display, a special software - Nextion Editor is used, which allows to easily add and customize various components (graphics, text, buttons, sliders, etc.) using the drag-and-drop feature. This is a great solution for monitoring and controlling applications, which can be applied to various IoT applications, such as smart home, industrial automation, medical equipment, etc.

The appearance of the Nextion display and Arduino are shown in figure 2:



Fig. 2 — Nextion display and Arduino

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INTELLIGENT CONTROL AND MONITORING SYSTEM FOR ELECTROMAGNETIC MASS ACCELERATOR GAUSS

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Аннотация. Данная статья описывает принцип управления и построения электромагнитного ускорителя масс Гаусса. Был проведён сравнительный анализ существующих аналогов на основе тиристоров. Определено, что существующие методы обладают недостаточной эффективностью по причине строгого расчета под определенные геометрические характеристики разгоняемого тела и физические характеристики элементов системы, что ведёт к несинхронности работы элементов системы по причине не идеальности компонентов и их деградации со временем. Был разработан метод управления системой на основе построения цифровой копии устройства с использованием датчиков слежения за положением тела и контроля состояния элементов системы, а также протекающих в ней процессов.

Ключевые слова: ускоритель массы Гаусса, электромагнитный ускоритель массы, сравнительный анализ тиристоров, метод управления системой, датчики слежения и контроля

Annotation. This paper discribes the principle of opperation and construction elecromagnetic mass accelerator Gauss. Exestant analogues on the basis of thyristors was comperatively analyzed. It is determined that existing methods have the lack of effencity caused by inflexible calculating for a specific geometrical characteristics of accelerated object and physical characteristics of system elements, that leds to non-synchronization work of the system elements that caused by components imperfection and their retrogression in time. Method of system managing on basis of construction digital copy of device with using object position and speed tracking sensors and processes condition and system elements condition control was developed. Keywords: voice control, partial automation, electromechanical modules, experimental device, energy saving

Keywords:Gauss mass accelerator, electromagnetic mass accelerator, comparative analysis of thyristors, system control method, tracking and control sensors

Introduction

In the modern world, many projects require the acceleration of capsules to high speeds in which the mechanical actuators that accelerate the cargo must be dispensed with. Electromagnetic mass accelerators are suitable for such requirements, such as electromagnetic mass accelerator Gauss. But such systems have disadvantages, such as:

- Low efficiency
- High component requirement
- High peak currents
- Low capacity per unit mass of portable power supplies

A smart control system based on one of the IoT paradigms, which states on necessity of building a digital copy of the device in use [1], can help reduce the impact of most of these problems and even negate some. The implementation of such a system will make it possible to monitor the status of many components of the system, which will not only prevent sudden failure of the device, but also increase the efficiency of the system by more precise dosing of energy supplied to the electromagnets that accelerate the accelerated object.

PRINCIPLE OF THE GAUSS MASS ACCELERATOR

Gauss electromagnetic mass acceleration named after german scientist Carl Gauss, who laid the foundation for the mathematical theory of electromagnetism. Gauss's electromagnetic mass acceleration consists of one or more solenoid coils that create a "running" magnetic field in which an object made of ferromagnetic material moves, similar in principle to a linear motor, as well as a control system that coordinates the inductors so that the accelerated object is not inhibited when it leaves the inductor. In this case, the ends of the accelerating object form poles oriented according to the poles of the coil, due to which after passing the center of the solenoid the object is attracted in the opposite direction, it brakes, which should be avoided by the control system to increase the efficiency of the system. As shown in Figure 1.



Figure 1 - Installation of a Gauss electromagnetic mass accelerator

Review of similar solution

In modern times, a pre-calculated thyristor inductor control system is most commonly used[2]. The source of its benefits and the potential drawbacks is the thyristor, which has a low channel resistance, but does not have the ability to close it at any time, which imposes restrictions on the flexibility of the system control.

Benefits of the thyristor system:

- Simplicity of design
- Relative cheapness

Drawbacks of thyristor system:

- Low efficiency
- Difficulty of calculations
- Less control flexibility.

System description

To eliminate the disadvantages of the thyristor control circuit, it is proposed to use n-type MOSFET transistors that allow not only open but also

close the current passage to the inductor, which, when using a more complex control system, opens up more flexibility in controlling the circuit and gives an opportunity:

- Disconnect power to the inductor when the capacitor is overcharged

- Use capacitors of higher capacity to maintain the declared kinetic energy of the object even if the power supply is degraded.

- Programmatically reduce the kinetic energy of the object by prematurely disconnecting the power supply to the inductor.

At the same time to control this type of keys is more difficult because of the presence of the gate capacity which must be charged to open the transistor and respectively discharged to close the key[3]. In this case the opening and closing times (1) should be much less than the inductor running times which depend on the geometric dimensions and the necessary speed increment (2). To solve this problem, the industry produces many MOSFET transistor drivers, this solution not only permit to quickly open even transistors with large gate capacitance, but also permit to monitor the current flowing through the transistor, protecting it from overcurrent.

$$t = 3 * \frac{O}{I} * C_G \tag{1}$$

$$t = \frac{2L}{\Delta v} \tag{2}$$

One of the main indicators of the control system will be the theoretically possible time of attraction of the object at flying out of the solenoid coil. Without taking into account the degradation of electrolytic capacitors with time, their high allowable deviation in capacity equal to an average of - 20% for new capacitors must not be neglected [4]. Using for calculations Thomson formula (3), the inductor operating time can be calculated. It will be by 9% more than necessary time, during which the object will be braked by the inductor, which in turn will lead to a decrease in the efficiency of the entire system, while simulation in the program Femm 4.2 with third-party add-on femm-coilgun[5]showed a drop in efficiency of 25%, while the energy of the accelerated object decreased by 10%.

$$T = \frac{\pi\sqrt{LC}}{2} \tag{3}$$

This can be avoided by monitoring the position of the accelerating object in the accelerator's barrel. Problem can be solved by using of infrared obstacle sensors, permanent infrared LEDs and infrared phototransistors, shining through holes in the barrelshown in Figure 2[6].



Figure 2 – Acceleration of the body in the barrel of the accelerator

- 1 The reproachable body
- 2 IR LED
- 3 IR phototransistor

All sensors are connected to the interrupt ports of the microcontroller, which reduces the delay to a minimum. Also knowing the transit time of each coil, we can calculate the speed (4) developed by the accelerated objects, which will make it possible to track abnormal changes in the operation of the system.

$$u_n = u_{n-1} + \frac{2L}{\Delta t} \tag{4}$$

In order to control the wear of the tube guide, a sensor is added at a certain distance from the inductors shown in Figure 3, that made it possible to calculate the sliding friction force of the accelerating object in the acceleration unit (5). The data collected not only help to calculate the operation of the circuit, but also in case of severe wear can inform the user about the malfunction of a particular component.



Figure 3 – General scheme

1,2,3 - solenoid coils 4,5,6,7,8 - Obstacle sensors $F = \frac{\Delta v_{8-7}}{t * m}$

(5)

Electrolytic capacitors are suggested as energy storage devices. They have a significant disadvantage, the capacitance decreases over time and the growth of internal resistance, leading to heating and even depressurization of the capacitor. To control this parameter it is proposed to charge the capacitor with a low voltage to measure the capacity by calculating it according to the formula(6)[7].

$$v(t) = IR(1 - e^{-t/\tau})$$
(6)

To control the elements of the system is proposed to use a microcontroller company "STMicroelectronics" series STM32F407. This

series of microcontrollers has sufficient performance to control all systems in real time, as well as a sufficient number of GPIO (general-purpose input/output - general-purpose input/output interface) allowing you to configure them as to interrupts and to ADC (analog-to-digital converter).





In the course of the work, an intelligent control system for the Gauss mass accelerator was powered and simulated. Simulations showed a 25% drop in efficiency with the new capacitors while reducing power by 10%.

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SHIPS GYROSCOPIC SYSTEMS

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Аннотация. Автор статьи исследует перспективы использования гироскопов на судах, их преимущества, конструкцию и технические характеристики.

Ключевые слова: гироскопы, судоходство, качка судна, конструкция судна, применение гироскопов на судах, характеристики гироскопов.

Annotation. The article explores the perspectives for the use of gyroscopes on ships, their advantages, design and technical characteristics.

Keywords: gyroscopes, navigation, ship pitching, ship design, use of gyroscopes on ships, characteristics of gyroscopes

The concept of gyroscopes

A gyroscope is a navigation device, the main element of which is a rapidly rotating rotor, fixed so that its axis of rotation can rotate.

The gyroscopic effect is created by the same centrifugal force that acts on the top rotating, for example, on a table.At the point of support of the top on the table, a force and a moment arise, under the influence of which the axis of rotation of the top deviates from the vertical, and the centrifugal force of the rotating mass, preventing a change in the orientation of the plane of rotation, forces the top to rotate around the vertical, thereby maintaining a given orientation in space.

Three axes of rotation of the gyroscope rotor are provided by two gimbal frames. If such a device is not affected by external perturbations, then the axis of proper rotation of the rotor retains a constant direction in space. If, however, a moment of an external force acts on it, tending to rotate the axis of its own rotation, then it begins to rotate not around the direction of the moment, but around an axis perpendicular to it (precession).

In a well-balanced and fairly fast rotating gyroscope, mounted on highly advanced bearings with little friction, there is practically no moment of external forces, so that the gyroscope retains its orientation in space for a long time almost unchanged. Therefore, it can indicate the angle of rotation of the base on which it is fixed. If the rotation of the axis of the gyroscope is limited by a spring, then, if it is properly installed on the vessel performing a turn, the gyroscope will deform the spring until the moment of the external force is balanced. In this case, the force of compression or tension of the spring is proportional to the angular velocity of the aircraft. This is the principle of operation of the aviation direction indicator and many other gyroscopic instruments. Since there is very little friction in the bearings, it does not take much energy to keep the gyroscope rotor spinning. A low-power electric motor or a jet of compressed air is usually sufficient to bring it into rotation and to maintain rotation.

The idea of gyroscopes on ships

Gyroscopes are most often used in shipping, aviation and astronautics. Almost every large seagoing vessel is equipped with a gyrocompass for manual or automatic control of the vessel, some are equipped with gyroscopic stabilizers. They are used as a sensitive element of indicating gyroscopic instruments and as a sensor for the angle of rotation or angular velocity for automatic control devices. In some cases, for example, in gyrostabilizers, gyroscopes are used as generators of moment of force or energy.

Gyroscopes for various purposes are produced in different sizes depending on the operating conditions and the required accuracy. In gyroscopic instruments, the rotor diameter is 4–20 cm, with a smaller value for aerospace instruments. The diameters of the ship's gyro stabilizer rotors are measured in meters.

For the first time, when sailors took to the ocean, calm sailing without pitching was an unimaginable, but very real idea. The motivation for solving this problem was also the wear of the vessel under the influence of external forces created during rolling. Seasickness, which remains the cause of suffering for many people, also plays a significant role.

However, today this problem has already been solved, albeit partially, thanks to gyroscopic stabilizers. Specialized companies produce a wide range of gyro stabilizers that keep the ship in a stable position thanks to anti-roll mechanisms.

The boat on the water is prone to pitching, but special stabilizers are used to eliminate it. The compact units effectively handle sway and help speed up boat movement as well as reduce fuel consumption. Rolling on the water is a frequent occurrence, but at the same time it poses a serious danger. If strong winds rage or a storm begins, a boat that is not equipped with a gyroscopic stabilizer may capsize. The gyroscope works in such a way that during the pitching it creates a counteraction to the applied force acting during the waves on the water.

Externally, gyroscopic stabilizers look like white spherical devices. Each device is equipped with a flywheel that rotates in vacuum to reduce friction and power consumption. Once installed on the ship, it creates a force that allows you to compensate for the pitching at sea. Flywheels rotate at up to 10,700 rpm, or 178 rpm. At this frequency of rotation, a point on the outer surface moves at a speed of about 900 km/h. Tolerances in the manufacture of parts are measured in microns and are several times smaller than the thickness of a hair.

The idea to use a gyroscope to stabilize a ship appeared more than 100 years ago.Thanks to the development of modern technologies used in the manufacture of automobiles, aircraft and spacecraft, in the development of the gyroscope, such techniques and equipment are used that give a result that was impossible before.

The first model of a gyroscopic stabilizer was developed for boats from 12 to 18 meters in length, which make up the bulk of recreational boats.

Bearings are a key part of a gyroscope.It is the bearing that creates restrictions on the speed, load capacity and service life of the parts.At first, they tried to use steel angular contact ball bearings in production, but then it was decided to abandon them due to too high friction and overheating.The advent of sealed precision SKF hybrid angular contact ball bearings solved the problem.

Flywheel bearings are sealed precision hybrid angular contact ball bearings. The bearing rings are made of stainless steel with a high nitrogen content. The balls are made of bearing silicon nitride, a type of ceramic composite material. Ceramic balls are much lighter and harder than steel balls.

The bearings in the universal joints are sealed SKF spherical roller bearings filled with the correct amount of appropriate grease, making them virtually maintenance free.A universal joint is a hinged support that allows an object to rotate around an axis.

Features and benefits of gyroscopic systems

Today, these devices can be used not only on large ships, but also on small fleets. The device is mounted inside the ship's hull. The principle of operation of the stabilizer is the formation of a powerful gyroscopic moment at the beginning of pitching. Inside the sphere, which is filled with a vacuum medium, a flywheel rotates. During the rocking of the vessel forward and backward, the damper begins to move from the port side to the starboard side. This effect allows you to counteract the roll of the vessel, and therefore maintain its level position in any operating conditions. Gyro stabilizers are one of the most compact gyro stabilizers. They effectively stabilize the boat, are easy to install and operate, with low power consumption and noise level. No special cooling system required.

The gyroscopic stabilizer has a wide range of advantages and features:

- compactness and high productivity;
- ease of installation and management;

- low power consumption;

- almost silent operation;
- long service life;
- installation of the cooling system is not required;

- reduction of pitching up to 85-90% depending on weather conditions.

The main technical characteristics of the gyroscope:

- rotation frequency: 5000 rpm;
- time to enter the operating mode: 14 min;
- maximum power consumption: 1400 W;
- supply voltage: 90-260 V, 50-60 Hz;
- noise level: less than 70 dB;
- dimensions: 48x48x53 cm;
- weight: 300 kg.

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IMPLEMENTATION OF THE LIMESDR-BASED LTE MOBILE BASE STATION RADIO PATH

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Аннотация. В статьерассмотрен вариант реализации радио-тракта базовой станции мобильной связи4G/LTE на основе использования интегрального приемного устройстваSoftwareDefinedRadio (SDR). В качестве эмулятора опорной сети определен вариант инсталляции бесплатного программного продукта с исходным кодом от srsRAN 4G [5]. Такой подход позволяетпровести исследования и проанализировать, как будет функционировать итоговое решение при развёртывания пилотной зоны мобильной связи. Определены возможности мобильной связи, которые доступны для тестирования надежности, задержек и многих других параметров. Возможно использование созданного эмулятора мобильной сети для обучения.

Ключевые слова: мобильная связь, базовая станция, SDR, 4G/LTE, srsRAN 4G

Annotation. The article considers a variant of implementation of 4G/LTE mobile base station radio circuit on the basis of Software Defined Radio (SDR) integrated receiver device. The variant of installation of free software product with source code from srsRAN 4G is defined as a reference network emulator [5]. This approach allows you to research and analyze how the final solution will function when deploying a pilot zone of mobile communications. Mobile communication capabilities are defined, which are available to test the reliability, latency and many other parameters. It is possible to use the created emulator of the mobile network for training.

Keywords: mobile communication, base station, SDR, 4G/LTE, srsRAN 4G

Introduction. Currently, most implementations of SDR devices are not always available for use by researchers due to the high cost. More affordable

is the LimeSDR integrated solution, which provides data processing in the frequency range from 100 kHz to 3.8 GHz. The LimeSDR platform from Lime Microsystems provides radio system designers and students with an intelligent and flexible radio signal manipulation device that enables research and development of new communication systems. The evaluations [3, 5] show that on the basis of LimeSDR it is possible to realize the operation of the radio circuit of 4G/LTE mobile network.

Main part. During the work it was decided on the basis of software radio system Radio Access Network 4 Generation (srsRAN 4G) to deploy 4G mobile network emulation, including the operation of the base station, the network core and user equipment. The appearance of the LimeSDR assembly kit is shown in Fig. 1.



Fig. 1 — Exterior view of the LimeSDR assembly kit

The central element of the LimeSDR-USB board is an Altera Cyclone IV programmable logic integrated circuit (FPGA) [4]. Its main function is to transfer digital data between PC and device via USB3.0 interface.

The structural diagram of the LimeSDR-USB board is shown in Fig. 2.



Fig. 2 — LimeSDR-USB development board schematic diagram The main elements of the structural scheme that determine the performance of the device are:

- -Cyclone IV FPGA in a 484-pin package;
- programmable logic array (FPGA) configurator;
- RF coaxial connectors;
- Dual-channel DDR2 memory device;
- Cypress high-speed USB controller.

As the hardware for software deployment a computer based on i5 9400 processor from Intel, with access to the Internet and connected LimeSDR via USB 3.0 interface was used. The structural diagram of the connection of the hardware elements of the 4G/LTE base station is shown in Fig. 3, where the LimeSDR module acts as a radio receiving interface RF frontend.



Fig. 3 — The structural diagram of connection of 4G/LTE base station hardware elements

The software part of the mobile network is implemented using the Linux operating system based on the Ubuntu distribution, additional libraries such as — libfftw3-dev, build-essential, libsctp-dev, ethtool, libzmq3-dev, libmbedtls-dev and many others, as well as the free open source software product from srsRAN 4G. Importantly, the srsRAN 4G suite is compliant with the 3rd Generation Partnership Project (3GPP). The developers of srsRAN 4G recommend using Ubuntu LTS (Long Time Support) distribution, as their work is more stable compared to conventional versions. The srsRAN 4G software package includes the following software modules: srsUE (User Equipment), srsENB (evolved Node Base Transceiver Station) and srsEPC (Evolved Packet Core).

The srsUE software module is a user equipment modem, or user equipment modem (UE LTE UE modem), fully implemented in the srsUE software, running as an application in a standard Linux operating system, connecting to any LTE mobile network and providing a standard network interface with high-speed mobile connectivity. To transmit and receive radio signals srsUE requires SDR equipment, the developers recommend Universal Software Radio Peripheral (Ettus Research USRP), as it allows to connect to the 5G network as well.

The srsENB software module is an LTE eNodeB base station fully implemented in software. Running as an application in a standard Linux operating system, srsENB connects to any LTE reference network (EPC) and creates a local LTE cell.

The srsEPC software module is a simplified implementation of a full LTE core network (EPC). The srsEPC application runs as a single binary file but provides key EPC components for the Home Subscriber Service (HSS), Mobility Management Object (MME), Service Gateway (S-GW) and Packet Data Network Gateway (P-GW).

After successful installation and setup of Ubuntu distribution kit, installation of additional libraries and srsRAN 4G software package you should connect LimeSDR to your computer via USB 3.0. Using a special

utility LimeUtil you should connect to LimeSDR and check if the software is up to date. If necessary it is obligatory to install updates for LimeSDR. After that LimeSDR will function as a base station radio module with standard 3GPP parameters. For more fine-tuning of LimeSDR it's possible to use LimeSuite software.

Further it is necessary to define available frequency range and power of the communication channel. To control the composition of the electromagnetic spectrum it is necessary to use spectrum analyzer. For example, 800 MHz in the downlink and 841 MHz in the uplink can be selected when implementing a system in LTE "band 20". These parameters are entered into configuration files enb.conf and rr.conf (parameters of both base station — gain for transmitter and receiver, measured in dB, and parameters of radio resource — frequency range).

A view of the signal spectrum in the 800 MHz range in the downlink is shown in Fig. 4.



Fig. 4 — Screenshot of the signal spectrum at 800 MHz in the downlink

The next step in setting up the base station is first of all to configure the parameters of the reference network. The connection between the core network and the base station is made via the S1 interface. In the network structure, the base station is the node between the operator's network and the subscriber's equipment. Therefore, when connecting to the base station, the subscriber is only registered in the operator's network if the subscriber data is present in the HSS database.

After launching the srsEPC and srsENB software packages, you should scan for network availability using a 4G smartphone. The result of the scan is a screenshot of the screen with a list of available networks of operators, shown in Fig. 5.

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3	2 5032 4G 5032	
2	2 5060 2G 5060	
4	2 5054 4G 5054	

Fig. 5 — A screenshot of the result of scanning operators' networks

As can be seen from Fig. 5, there is a Test PLMN 1-1 4G network among the detected networks, which stands for PLMN (Public Land Mobile Network) or Public Land Mobile Network. The configuration specifies combinations of MCC (Mobile Country Code) and MNC (Mobile Network Code), which distinguishes the operator's radio access network. The first three digits are the MCC or Country Code, and the next two digits are the MNC or Network Operator Code.

For further connection of the subscriber's equipment, it is necessary to have sim card data in the HSS base. These are the parameters of the authentication algorithm, the international mobile subscriber identifier (IMSI), the secret key (KI) and the operator code or derived operator code (OP/OPc). These parameters are set by the service provider in its HSS database.

When configuring the software, the difficulty arose in terms of reconfiguring the Ubuntu kernel from generic to lowlatency, for better srsENB performance. Since the LTS version of the distribution is constantly updated, and with the release of a new version of the system the kernel was at the stage of test builds.

The laboratory bench provides the ability to connect to the 4G base station using a smartphone or connection from the srsUE software module deployed on a second computer with the Ubuntu system installed and the LimeSDR module connected. Thanks to this you can not only connect to the base station, but also conduct research by experimenting with the communication channel, changing the carrier frequency, transmission modes, bandwidth. It is possible to realize the technique of intercepting packets with the help of Wireshark packet analyzers. Hardware-software complex allows you to consider the work at different QoS levels. In addition, the equipment will allow testing the characteristics of the base station and subscriber equipment by analogy with [1, 2].

Conclusion. In the course of reviewing a variant of 4G/LTE base station deployment with a backbone network, peculiarities of hardware and software operation were identified as well as the results of 4G/LTE cellular communication functioning in different modes were demonstrated. In the course of further research it is planned to perform load testing of the network operation for several subscribers.

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TESTING METHODS FOR REDUCING THE IGNITION ADVANCE ANGLE IN THE PETROL ENGINE OF A FORMULA STUDENT RACE CAR

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Аннотация.В статье описывается разница между системами зажигания в двигателях внутреннего сгорания гоночных автомобилей класса Formula Student. В качестве примера были выбраны два двигателя от мотоциклов КТМ 690, выпущенных в 2014 и 2011 годах. Двигатели были установлены на динамометрический стенд и после тестирования были установлены на два гоночных автомобиля, построенных командой Togliatti Racing Team для участия в международных инженерно-спортивных соревнованиях Formula Student: Red Scorpion G3 и Black Scorpion G1. Уменьшение угла опережения зажигания с помощью комбинации методов показало увеличение КПД на 11%, то есть 66% КПД у второго кандидата по сравнению с 55% КПД первого.

Ключевые слова: бензиновый двигатель, КПД, угол опережения зажигания, динамометрический стенд, испытания.

Annotation. This article describes the difference between ignition systems in internal combustion engines of two Formula Student race cars. As an example we chose two engines for KTM 690 motorcycles produced in 2014 and 2011 respectively. These engines were installed into a dyno stand and after testing they were installed into two race cars built by Togliatti Racing Team for participatingin international engineering Formula Student competitions: Red Scorpion G3 and Black Scorpion G1. Reducing the ignition timing using a combination of methods showed an increase in efficiency by 11%, i.e. 66% efficiency for the second candidate compared to 55% efficiency for the first one.

Keywords: petrol engine, efficiency, ignition advance angle, dynamometer stand, testing.

Presently, one of the urgent objectives of engine design is to reduce the amount of harmful emissions in the form of exhaust gases and to increase the service life of the catalytic converter of vehicle exhaust systems to preserve the ozone layer and increase engine efficiency. In addition, there are obvious problems with supply of electric components to the Russian market, which prevents the introduction of electrification of urban and municipal vehicles and the lack of available conditions for work in the northern territories, where 14% of the Russian population live.

The aim of the present research is to show the result of decreasing the ignition timing depending on the change in the configuration of the ignition system. In the present research we tested ignition systems of internal combustion engines of Formula Student race cars. As an example, we chose two engines from the KTM 690 motorcycles produced in 2014 and 2011. These engines were installed into a dynamic stand (Fig. 1) and after testing they were installed into two race cars built by Togliatti Racing Team for participating in Formula Student competitions: Red Scorpion G3 and Black Scorpion G1.



Fig. 1 – Testing petrol engines on the dynamometer stand

Red Scorpion G3 received a KTM 690 engine produced in 2014. The data sheet for this engine is the following:

- \checkmark the number of strokes is 4;
- \checkmark the number of cylinders is one;
- \checkmark the type of the valve train is SOHC;
- \checkmark the number of valves per one cylinder is 4;
- \checkmark the engine volume is 690 cc;
- ✓ piston diameter 102 mm and stroke 84.5 mm;
- \checkmark the engine power is 67 hp at 7500 rpm;
- \checkmark its torque is 70 N/m at 6550 rpm;
- \checkmark the combustion chamber is 12.6:1;
- ✓ two spark plugs per 1 cylinder.

Black Scorpion G1 received a KTM 690 motor that was produced in 2011. The data sheet for its engine is the following:

 \checkmark the number of strokes is 4;

- \checkmark the number of cylinders is one;
- \checkmark the type of the valve train is SOHC;
- \checkmark the number of valves for one cylinder is 4;
- \checkmark the engine volume is 690 cc;
- ✓ diameter bore and stroke load 2M and 84.5 mm;
- ✓ the engine power is 62 hp at 7500 rpm;
- ✓ its torque is 65 N/m at 6550 rpm;
- \checkmark the combustion chamber is 11.8:1;
- ✓ one spark plug per 1 cylinder.

According to the FS-Rules 2022 [2], the restrictor of the intake system must have a diameter of up to 20 mm, which requires manufacturing a new intake system and tuning the ECU and, accordingly, optimization of ignition timing. The receiver was manufactured by the student engineering team as part of the Formula Student project. To perform this task we used the following methods of reducing the ignition timing [1]:

1. Replacing spark plugs with a metal heating element with iridium ones. Iridium has an electrical resistance of 5.3 kOhm, while metal has an average of 7.5 kOhm, which allows more current to flow to the plug heating element and gives a stronger spark to ignite the fuel.

2. Stabilizing spark strength by replacing the high-voltage wires with a glass-carbon fiber conductor. Standard high-voltage wires have copper and chrome current conductors, which together have the same resistance as that of glass fiber or carbon (0.017*10-8 Ohm*m), but have worse electrical conductivity while increasing operating temperatures, which will keep the ignition timing in various operating conditions.

3. Replacing an ignition coil with a coil or module with higher performance (depending on the ignition system configuration) that has an operating voltage at the tip output of more than 20 kV to improve the initial charge delivered to the spark plugs.

4. Using two or more spark plugs per cylinder depending on the combustion chamber configuration and the valve train in the cylinder head. This method will result in a more even ignition of the fuel.

5. Increasing the compression ratio to reduce the ignition advance angle. Engine efficiency increases due to an increase in the angle between the piston rod and crankshaft, because of the reduction of mechanical losses exerted by the ignition start pressure.

After testing was completed we obtained the following results. Settings were done on a dynamometer stand and tested on a driving range with engines from KTM 690 LC4 motorcycles with different cylinder heads and ignition systems.

The first candidate was equipped with a 17 kV ignition coil and one spark plug. The compression ratio was 11.8. The second candidate received

individual ignition coils, two spark plugs with an iridium heating element and an increased compression ratio of 12.6. After adjusting the ignition timing and fuel maps the following results were obtained. The first candidate: engine power of 40 hp, torque of 41 N/m, fuel consumption of 13 liters per 100 kilometers. The second candidate: engine power 46 hp, torque of 48 N/m, fuel consumption 10.5 liters per 100 kilometers.



Fig. 2 - Full-load curve of engines with different ignition systems

After performing all the tests, we found out that reducing the ignition timing using a combination of methods revealed an 11% increase in the efficiency of the engines: 66% efficiency for candidate 2 compared to 55% efficiency for candidate 1.

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UDC 62-9

POWER SOURCES ON SHIPS. SHIPS GENERATORS Kirill Grishenko

3rd year cadet, Departmentof Electrical Equipment of Ships and Automation of Production, Kerch State Maritime Technological University e-mail: grishenkokeril@mail.ru Svetlana Frolova senior lecturer of the Department of Foreign Languages Kerch State Maritime Technological University Аннотация. В статье определяется невозможность работы судна без электроэнергии, а следовательно, без электропитания. Уточняется, почему именно генераторы как источник питания используются на судах. Перечисляются виды генераторов и дается их краткая характеристика как конструкции, так и назначения. Особое внимание уделяется их выбору в соответствии с требованиями морского регистра судоходства.

Ключевые слова: источник энергии, генераторная установка, преобразователь, дизельный генератор, первичный двигатель, генератор параллельного возбуждения, генератор последовательного возбуждения.

Annotation. The paper defines the impossibility of any ship running without electrical power and hence without power sources. It is specified why generators, at the first turn, are used on board shipsas power sources. Kinds of generators are listed and their properties according to their constructions and purposes are given. The special attention is given to their choice in accordance with the requirements of Register Rules.

Keywords: power source, generating set, convertor, diesel generator, prime engine, parallel excitation generator, series excitation generator.

On modern ships, it is impossible to dosomething without power sources. After all, all the devices and equipment there work on electricity, and you can get it only using ship models. Such devices are much cheaper and significantly save money on the operation of ships, yachts, ships and ferries. Any lighting devices, power plants, communication equipment can be connected to it [4].

Marine generators are distinguished by the most minimal maintenance, high reliability, a long period of operation without breakdowns, as well as the possibility of manufacturing equipment to order, for individual characteristics. The kit of a conventional marine unit includes the power plant itself, a universal hand pump for pumping oil, an exhaust and a remote control with a long cable that can be carried outside the room in which the installation is located.

If it speaks about the purpose of the unit, then they are conditionally divided into emergency and auxiliary devices. In addition, there are devices of constant or alternating current, single-phase and three-phase models. Depending on the design, they can be frame, flywheel and flanged. Recently, compact marine units have appeared on the market, which have a number of advantages over stationary ones. They are small in size and take up little space, so you can safely use them on small boats, yachts. Such devices will fit perfectly in the engine compartment or hold. All ship's samples have excellent protection in the form of a sturdy hull that protects against falls and bumps. It is worth noting that new sensors of the device status, waterproofing and casing are presented here, which will ensure quiet operation of the equipment.

Manufacturers guarantee high-quality operation of the unit, the production of stable voltage even in extreme conditions. Such devices can tolerate both too high temperature conditions and severe frosts. In addition, they are able to work in conditions of a strong inclination of the vessel.

All the details of the structure are hidden, but in case of breakage they can be easily replaced. The ship's crew will be able to install the unit itself and launch it, because it is quite simple to operate.Marine generators are smartly protected from vibration, because they are equipped with soft shock absorbers.

The units for ships must be powerful enough to run all the electrical appliances on the ship. In addition, it is necessary to take into account the starting currents, which in this case are much larger than household equipment. Such a technique is also chosen depending on the operating modes of the ship. These can be maneuvers, running or fishing modes. It is also necessary to install a backup power supply, which will be connected in case of a breakdown of the main one.

Basically, marine units are produced with diesel fuel.

Ship power sources.

Generators with autonomous drive (generator sets), power take-off generators and accumulators are used as sources of electricity on ships. If the type of current or voltage and frequency values adopted for a ship's power plant differ from the nominal parameters of some consumers, then electric energy converters are used.

Generator sets (HA) are the most important elements of power plants and consist of a primary engine and a generator.

Primary engines can be diesels, steam reciprocating machines, steam and gas turbines. Therefore, HA are respectively called diesel generators, steam generators, turbo generators and gas turbine generators.

Currently, diesel generators and turbo generators are mainly used. Steam generators are rarely used even on small ships because of their bulkiness and low efficiency, and gas turbine generators are just beginning to be introduced.Generator sets are divided into main units (reserve units can also be attributed to them), parking, emergency and special purpose, for example, for powering trawl winches of fishing vessels.

Power take-off generators from the main marine engines provide electricity to consumers in the running mode. The use of the main engine as a single source of energy is carried out in two ways: the use of power takeoff from the main engine to drive the generators; the use of exhaust gas energy utilization to power the turbo generators.

The installation of power take-off generators on ships is due to a number of advantages and is of great practical importance. Batteries on ships are used as emergency sources of electricity, the main source of small emergency lighting, as a buffer current source when using halogen generators, for starting internal combustion engines, etc. Acid and alkaline batteries are used on ships [3].

Electric energy converters convert one kind of current into another, or one voltage and frequency values into another. They can be rotating and static.Rotating ones include two-machine and single-core converters. Twomachine converters consist of two electric machines (motor and generator) mounted on a common foundation frame and connected by a coupling. Twomachine converters take up a lot of space, are heavy, relatively expensive and have low efficiency. Therefore, single-core converters are more often used.

Single—core converters are DC machines with a collector on one side of the armature, and on the other — contact rings (three for three—phase and two for single—phase converters) connected to the armature winding. A single-core converter can convert direct current to alternating current, or vice versa. If a single-core converter is rotated by some kind of motor, it will simultaneously generate both direct and alternating current.

Static converters include: ion and electronic converters; uncontrolled and controlled semiconductor converters. Semiconductor converters have become the most widespread on ships. According to the type of valves used, they are divided into cuprox, selenium, germanium and silicon.

Generator sets

Any generator set, as already noted, consists of a primary engine and a generator.

Primary engines. The choice of the type of primary engine of marine generators is usually determined by the type of the main ship installation. If the main engine on the ship is diesel, then diesel engines are used as the primary engines of generators.

If steam turbines are installed as the main engines, the primary engines of the generators are steam turbines. However, diesel generators are usually installed on these vessels. They provide the ship with electricity in emergency situations and parking in the port, when the operation of turbo generators is impossible or economically impractical.

The use of diesel engines as primary engines of marine generators is advisable, since they are economical, compact, autonomous and require relatively simple and small preparation time for start-up.

Currently, diesel engines with a rotation speed of 500-750 rpm and 1000-1500 rpm are mainly used. High-speed diesel generators are lighter than

low-speed ones, take up less space, are cheaper and have a higher efficiency. However, they have less engine life and are very noisy. Diesels allow the possibility of working with an overload of 10% of the rated power for one hour.

Marine diesel generators (DG), according to the method of connection with primary engines, are divided into:

DGR-a frame diesel generator, in which the diesel and the generator are not structurally connected; the generator has two bearing shields and is connected to the diesel using a rigid or elastic coupling;

DGF is a flanged diesel generator, the generator of which is attached to the diesel using a flange and can have one or two shields;

The DGM is a flywheel diesel generator; the generator in this case has one bearing on the side opposite to the diesel, and its shaft is rigidly connected to the crankshaft.

Turbo generators have longer service life and reliability compared to diesel generators. They rotate evenly, so the parallel operation of turbo generators is more stable than diesel generators. At the same time, they are less economical, it is necessary to warm up the turbine for a relatively long time before starting, and in the event of an accident of the boiler plant, the vessel turns out to be de-energized. Turbogenerators mainly have a frame design and the turbine is connected to the generator directly or through a gearbox.

Recently, gas turbine generators have been used on ships, which combine the advantages of a steam turbine and a diesel engine. Gas turbine generators have a small mass and dimensions per unit of power of the installation. They are reliable in operation, start up quickly and have a relatively long service life (10,000 hours). At the same time, gas turbine generators have high noise, high specific fuel consumption and other disadvantages that hinder their widespread use on ships.

The main requirements of the Register Rules for the primary engines of generators:

- the rated speed must differ from the critical speed of the primary engine by at least 20%;

- primary engines of generator sets operating in parallel must have identical mechanical characteristics;

- the speed regulators of the primary motors during full load surges and resets must ensure automatic maintenance of the rated speed within the following limits: instantaneous change — no more than 10% of the nominal value;

- the steady speed of rotation should not differ from the nominal by more than 5%;

- the time to reach the new steady—state rotation speed is no more than 5 seconds;

- the design of the primary motor regulators should provide for the possibility of remote change of the rotation speed within \pm 10% of the nominal value;

- if the primary engine, in addition to the main speed controller, has a limit regulator, then the latter should automatically stop - the supply of steam (fuel) when the speed increases by 15% above the nominal;

- turbogenerators with forced lubrication must be carried out in such a way that in the event of a pressure drop in the lubrication system, the turbine stops and the generator is disconnected from the switchboard tires.

Ship generators. Generators of both direct and alternating current are used as generators of ship power plants [5].

Parallel excitation DC generators must have automatic voltage regulators that ensure voltage stabilization with an accuracy of $\pm 2.5\%$ of the nominal value. However, in DC power plants, mixed excitation generators (compound) are usually used. Voltage self-regulation is performed by means of an excitation winding depending on the load current without any external regulating devices.

According to the Rules of the Register, the voltage change of mixed excitation generators when the load changes from 20 to 100% of the nominal value should not exceed 5% for generators with a capacity of up to 15 kW, 4% — from 15 to 50 kW, 3% - over 50 kW.

On ships DC generators of the P series have become the most widespread. They are manufactured at a power from 3 to 200 kW, with a voltage of 115, 230, 320 and 460 V, have heat-resistant glass-and-mica insulation and are made in a splash-proof design. Synchronous generators are usually used as alternators in marine power plants. The MS generators have a machine exciter, and the rest of the generators are self-excited. The voltage and frequency of alternating current generators change significantly when the load and its nature (cos f) change. Therefore, the primary motor of the generator set is supplied with a speed controller, and the synchronous generator is supplied with a voltage regulator. Shipboard synchronous generators (SSG) are most often manufactured in a splash-proof design. They can have an open or closed cooling system. The open cooling system of the generator, in turn, can be self-ventilated when the fan is part of the machine, and with independent cooling when the fan is placed outside the machine. When the cooling system is open, air coming from the environment passes through the generator. This air is polluted and contains a significant percentage of petroleum vapors, which leads to contamination, deterioration of ventilation and, consequently, heating of the generator. In addition, the electrical insulation of the generator windings is rapidly destroyed.

Therefore, to eliminate these shortcomings, currently in generators (for example, types of MSK: M — marine, C — synchronous, K — organosilicon insulation) use a closed-loop cooling system with air cooling in a water air cooler. The air cooler consists of a battery of ribbed tubes through which seawater is pumped. With this cooling system, the ingress of petroleum vapor and dust into the generator is excluded. The disadvantage of a closed generator cooling system is the complication of the generator design and the increase in its cost.

According to the Rules of the Register, the voltage of shipboard alternators must be maintained within $\pm 2.5\%$ of the nominal value [1].

The generator must have an excitation reserve so that in the event of an overload with a current equal to 150% of the nominal value at $\cos f = 0.6$, the rated voltage is maintained with an accuracy of 10% for 2 minutes. The voltage of the alternator operating in normal operating mode should not decrease below 85% and rise above 120% of the nominal value with a sudden change in the symmetrical load. At the end of the transient process, the generator voltage should be restored within \pm 3% of the nominal value for no more than 1.5 seconds. In general, marine generators of direct and alternating current must have a minimum weight and dimensions; have high reliability in operation; ensure the receipt of electricity of the required quality, i.e. they must maintain voltage, and in the case of alternating current and frequency, within specified limits in all operating modes; have a high efficiency; be easy to operate; be ready to work in specific marine conditions, etc. Currently, much attention is paid to the development and research of new methods of direct generation of electricity from thermal or chemical energy of fuel. Electrochemical. thermo-emission. thermoelectric magnetohydrodynamic generators may be of practical interest to the marine electric power industry in this regard. Generator sets are the most important elements of ship power plants, therefore, special attention should be paid to the issue of their operation. The serviceable condition of electric generators operating with rated load at rated voltage and speed is characterized by: normal heating of the generator and its individual parts; absence of sparking under the brushes; normal insulation resistance of all its current-carrying parts; permissible vibration rate of its housing. Excessive heating of generators leads to damage to the electrical insulation of its windings and current-carrying parts, as a result of which a short circuit may occur. Therefore, during operation, maintenance personnel must constantly monitor the heating temperature of the generators. In case of unacceptable heating of the generator, it should be immediately taken out of operation and the cause of this abnormal condition should be eliminated.

Nowadays the power sources on the base of heat engines and rotating electrical machines, at the first they are diesel generators, are commonly used

on board ships. Tightening of ecological rules and rise in fuel prices cause the necessity and practicability of alternating sources of electrical power searching which can be used as the main ones on board ships [2].

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UDC 621.375 EXTERNAL SOUND CARD FOR SIMULATING OF NOISE IN THE CAR INTERIOR

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Аннотация. Приведены результаты разработки внешней звуковой карты для моделирования шума в салоне автомобиля. Внешняя звуковая используется составе измерительной установки, карта в предназначенной для проведения испытаний акустического канала абонентского терминала, установленного внутри салона транспортного ЭРА-ГЛОНАСС. средства, системы Измерительная установка испытания позволяет проводить системы аварийного вызова экстренных служб в лабораторных условиях.

Ключевые слова:внешняя звуковая карта, система ЭРА-ГЛОНАСС, акустическая система.

Annotation. The results of the development of an external sound card for modeling noise in the car interior are presented. An external sound card is used as part of a measuring unit designed to test the acoustic channel of the subscriber terminal installed inside the vehicle interior, the ERA-GLONASS system. The measuring unit allows testing the emergency call system of emergency services in laboratory conditions.

Keywords: external sound card, ERA-GLONASS system, acoustic system.

The ERA-GLONASS system provides accurate positioning of an object in space with minimal error. The main function that GLONASS household terminals perform is global navigation for transport. The system is designed to enable emergency services to respond as quickly as possible to car accidents and other incidents.

The emergency services are informed about the incident by a subscriber terminal installed in the car (fig.1). To determine the exact location, special equipment is used, which, with the support of ground infrastructure, communicates with a network of satellites placed in near-Earth orbit. The accuracy of the coordinates depends on the number of satellites that have received a request from the terminal, the more satellites respond to the request, the more accurately the coordinates will be determined.



Figure 1 – A subscriber terminal

The terminal configuration is determined by the technical regulations
adopted in the Customs Union [1, 2]. According to the requirements of these regulations, the device must include: a button to activate the system in manual mode (Fig. 1); navigation module (GPS/GLONASS); GSM modem for transmitting information over a mobile network; intercom (microphone + speaker); indicator unit; sensors that record an emergency (Fig. 2). The terminal is connected to accident sensors that record side collisions, rear and front impacts, and also vehicle flips. When emergency sensors are triggered or when the "alarm button" is pressed, emergency services are called using a mobile communication system. The digital alarm signal that comes from the technical means contains information about the location determined using the GLONASS satellite system, the sensor response time, the vehicle identification number.



Figure 2 – The call-center.

After receiving a digital emergency message, the ERA-GLONASS emergency service operator communicates with the emergency vehicle in voice mode. If there is no response or the driver or passengers ask for help, the information from the operator goes to the unified coordination center of emergency services. In a single center, they determine who exactly to send to the accident site, and also coordinate for more effective joint work of ambulance crews, firefighters, rescuers. The problem faced by users of the system is a clear communication of information to the call-center.

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Often due to external factors, such as vehicle noise, on the road, weather conditions, information is received incorrectly. Operators often cannot hear what happened, so our device is designed to test a car intercom for compliance with regulatory documents in laboratory conditions on special stands [3]. The placement of the system elements in the car interior is shown in Fig. 3.



Figure 3 – The placement of the system elements in the car interior

The sound card is designed for recording and reproducing sound in high quality. Standard commercially available sound cards do not satisfy the required dynamic range of the ADC. We use an external sound card in our project (Fig. 4), for reproduce the sound of a higher quality, without noise and distortion when recording it.

Testing of an automobile intercom device for compliance with regulatory documents is usually carried out not in road conditions on moving vehicles, but in laboratory conditions on special stands.



Figure 4 – An external sound card

One should consider the block diagram shown in Fig. 4. The developed device contains: a personal computer with software (PC with software), in whose memory there is a database of pre-recorded acoustic noises created in the cab of the vehicle when it moves on roads of various types, an external sound card containing a USB splitter (USB Hub) and two two-channel digital-to-analog converters (DAC) made on a PCM2705 chip with a built-in USB interface having a dynamic range of 98 dB, four low-frequency filters (LPF), four broadband channels (UHF) and one subwoofer (SUB). That is, the chip selected for development allows you to get the required (more than 80 dB) dynamic range.

From a computer with certain software via USB hub, we feed an audio track with the necessary noise corresponding to certain operating conditions

(type of road, type of moving vehicle, etc.) to a digital analog converter (DAC). Since the signal is in digital format, it needs to be converted to analog. Since we need 4 channels to play, we use two two-channel sound cards. Then the signal is fed to the low-pass filter in order to block the transmission of high-frequency components. Then the signal goes to 4 low-frequency amplifiers, providing power in each channel of 60 watts, and to a subwoofer with a power of 240 watts.

The acoustic system must create a noise level in the vehicle interior of at least 90 dB. To meet this requirement for various types of vehicles, the Edifier 760D speaker system was selected, which has broadband channels with a power of 60 watts and one subwoofer with a power of 240 watts.

Conclusion.

Thus, an external sound card has been developed, which can be used to simulate in laboratory conditions external acoustic noises in the vehicle interior during tests for compliance with regulatory documents of automotive devices of the ERA-GLONASS system.

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CALCULATION OF THE EFFICIENCY OF THE AMPLIFIER STAGE OPERATING IN THE H MODE

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Аннотация.

Проведён анализ усилительного каскада, работающего в режиме *B* с изменяемым напряжением цепей питания [2, 3]. Найдено выражение для расчёта коэффициента полезного действия (КПД) каскада при двухступенчатом изменении напряжения цепей питания. Проанализировано влияние режима *B*с изменяемым напряжением цепей питания на выделяемую при работе рассеиваемую мощность. Рассмотрены преимущества и недостатки усилительного каскада. Получено, что для реальной звуковой фонограммы использование двухступенчатого напряжения питания позволяет повысить КПД каскада примерно в два раза.

Ключевые слова: усилитель, класс *H*, коэффициент полезного действия, изменяемое напряжение цепей питания, рассеиваемая мощность.

Annotation.

The analysis of the amplifying cascade operating in mode B with variable voltage of the supply circuits is carried out [2, 3]. An expression has been found for calculating the efficiency of the cascade with a two-stage voltage change of the supply circuits. The influence of mode B with variable voltage of power supply circuits on the dissipated power released during operation is analyzed. The advantages and disadvantages of the amplifying cascade are considered. It is found that for a real sound phonogram, the use of a two-stage supply voltage allows to increase the efficiency of the cascade by about two times.

Keywords: amplifier, class H, efficiency calculation, variable voltage of power supply circuits, power dissipation.

Amplifying cascades that have a variable supply voltage in their design most often have a generalized block diagram shown in Fig. 1 [1]. According to the principle of variable supply voltage, they are divided into:

- switchable power amplifier;

— an amplifier with a smoothly varying voltage of the power supply.



Figure 1 – Variable supply voltage

The principle of operation of the cascade with switchable power supply is to use different levels of supply voltage depending on the amplitude of the output signal [5]. As a rule, it has two power sources, namely an enlarged power supply and a standard power supply. The power supply of the output stage of the control circuit chooses between two values and thus the amplifier is sometimes called a "power switch". The schematic diagram of the amplifier is shown in Fig. 2. The output signal of such an amplifier is shown in Fig. 3.



Figure 2 – The output signal



Figure 3 - The output signal

The principle of operation with a smoothly varying voltage of the power supply is that the power supply monitors the input signal level and maintains the voltage on the transistors to a set value when the switching threshold is reached [5]. The output signal of such an amplifier is shown in Fig. 4.



Figure 4 - The output signal

One should move on to calculating the efficiency of a class H amplifier. The calculation itself consists of two parts, this is the calculation for the input signal having an amplitude up to the lower threshold value (E) and for the signal exceeding the threshold (E). Below is the calculation.

It is known that the power taken from the power supply by the cascade operating in mode B can be determined from the expression

$$P_{p.s.} = \frac{2}{\pi} \cdot I_l \cdot E$$

The power given by the amplifier stage to the load is determined from the expression

$$P_l = \frac{1}{2} \cdot U_{out} \cdot I_l.$$

Taking into account the expressions, we obtain a formula for calculating the efficiency of the cascade

$$\eta = \frac{P_l}{P_{p.s.}} = \frac{\frac{1}{2} \cdot U_{out} \cdot I_l}{2 \cdot E \cdot I_0} = \frac{1}{4} \frac{U_{out}}{E} \cdot \frac{I_l}{\frac{1}{2} \cdot I_l} = \frac{\pi}{4} \cdot \frac{U_{out}}{E},$$

where E — is the threshold voltage of the cascade supply; U_{out} — is the amplitude of the output signal; I_i — is the amplitude of the current in the load.

The final efficiency formula has the form:

5)

$$\begin{split} \eta &= \frac{\pi}{4} \cdot \frac{U_{out}}{E} \text{ if } 0 < U_{out} \leq E; \\ \eta &= \frac{\pi}{4} \cdot \frac{U_{out}}{2E} \text{ if } E < U_{out} \leq 2E. \end{split}$$

According to these formulas, the efficiency graph takes the form (Fig.



Figure 5 – The efficiency graph

When comparing the statistical data on the amplification of musical phonograms for a class H amplifier and a class B amplifier, the efficiency of which is shown in Fig. 6, it can be assumed that the peak factor is at the level of 0.3 of the maximum value. When a signal passes through a Class B amplifier, the gain efficiency at 0.3 is equal to 24%, in turn, at the same level, the class H amplifier has an efficiency of 48%.



Figure 6 – Class *B* amplifier

A Class *H* amplifier emits much less heat compared to Class *B* (Fig. 7) by dividing the power supply into two or more levels and switching to the desired one according to the signal amplitude. This significantly improves heat dissipation in the cascade by providing low voltage at a low signal level (Fig. 8) [4].



Figure 7 - Class H amplifierFigure 8 - Heat dissipation in the cascade

Figure 8 shows that a Class *H* amplifier leads to significant savings, it is more efficient in a wide dynamic range of amplitudes.

Disadvantages of a Class *H* amplifier. There is a switching time between power sources, as a result of which distortions may occur on the high frequency component. The filter at the output of the cascade will help to correct this shortcoming.

Practical application. The scope of application is to work in devices where energy savings and minimal heat generation are required, for example in cars, as well as in mobile radio frequency communications. But they are also often used in conventional sound amplifiers.

Conclusion

In the course of the work, the principles and basics of the operation of the amplifier stage in the H mode were studied. Expressions of the efficiency of the cascade are obtained, and graphs of the dependence are given. The calculations themselves showed that the use of a two-stage supply voltage can increase the efficiency of the cascade by about two times.

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DEVELOPMENT OF A WI-FI MODULE FOR UAV CONTROL

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Данная Аннотация. статья рассказывает о возможности использования Wi-Fi модуля ESP32 для передачи команд по протоколу MAVLink на полетный контроллер Ardupilot. Описывается принцип передачи команд и использование библиотеки для работы с протоколом MAVLink микроконтроллере ESP32. Также на отмечаются преимущества и недостатки данного метода управления беспилотными летательными аппаратами в сравнении с существующими аналогами.

Ключевые слова: Wi-Fi, ESP32, MAVLink, полетный контроллер, Ardupilot, беспилотные летательные аппараты, управление, передача команд

Annotation. This article describes the possibility of using the ESP32 Wi-Fi module for transmitting MAVLink protocol commands to the Ardupilot flight controller. It explains the principles of command transmission and the use of a MAVLink library on the ESP32 microcontroller. Additionally, the advantages and disadvantages of this method of controlling unmanned aerial vehicles compared to existing analogs are highlighted.

Keywords: Wi-Fi, ESP32, MAVLink, flight controller, Ardupilot, unmanned aerial vehicles, control, command transmission

1. Introduction

In the modern world, drones have become an integral part of our lives. They are used in various fields, from delivering goods to filmmaking. Drone control can be carried out using different devices and in different radio frequency ranges, including Wi-Fi.

The ESP32 microcontroller can be used to transmit commands to the drone's flight controller via Wi-Fi [4]. It has a built-in Wi-Fi module, which eliminates the need for additional modules and simplifies the design. This article will discuss the use of the ESP32 microcontroller for drone control using the MAVLink protocol and the Ardupilot flight controller.



Pic. 1-ESP32 diagram

2. Problem statement

Various devices and methods are used to control a drone, such as remote control units or radio receivers. However, not all of them are convenient and accessible. In some cases, the use of radio frequency communication is not possible or desirable, for example, in enclosed spaces or urban areas with high population density, and they can also complicate the use and increase the cost of the control system.

Therefore, there is a need to find a more convenient and accessible way to control a drone that would avoid the limitations of radio frequency communication and allow the use of existing devices such as smartphones and tablets.

3. Comparison of analogs

Transmission of drone control signals using radio transmitters and Wi-Fi has several significant differences.

Radio transmitters are used to transmit signals over longer distances, have higher resistance to interference, and lower signal transmission delay, while Wi-Fi has limited range and may face interference from other Wi-Fi networks or electronic devices[1].

However, using Wi-Fi to control a drone has several advantages. Firstly, Wi-Fi is available almost everywhere where there is access to the Internet, while radio transmitters require free radio frequencies and corresponding permissions for their use. Additionally, Wi-Fi is more accessible and cheaper to use than radio transmitters.

It is also worth noting that transmission of drone control signals via Wi-Fi provides a higher data transmission speed when transmitting large data packets.

4. Approachtosolvingtheproblem

The Wi-Fi module ESP32 can be used to transmit commands via the MAVLink protocol to the Ardupilot flight controller. To do this, the ESP32 must be connected to the flight controller via a UART port. Then, a library for working with the MAVLink protocol is installed on the ESP32, which

allows the creation of data packets and their transmission to the flight controller.

The MAVLink protocol is a message exchange protocol for unmanned aerial vehicles [3]. It allows the transmission of various data about the drone's status, as well as commands for controlling the flight. To transmit commands via the MAVLink protocol to the ESP32, a Wi-Fi module is used, which provides wireless communication with the ground station.

MAVLink v1	Frame	(8 -	263	by	tes)
		1		_	/

STX	LEN	SEQ	SYS	COMP	MSG ID	PAYLOAD (0 - 255 bytes)	CHECKSUM (2 bytes)
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Pic. 2 - Mavlink frame

The principle of transmitting commands via the MAVLink protocol involves creating data packets with a specific structure. Each packet contains a header and payload in the form of a byte sequence, which can contain different types of messages.

After the data packet is formed, it is sent via Wi-Fi to the Ardupilot flight controller. In response to each packet, the controller sends a confirmation of receiving the command [2].

Thus, the principle of transmitting commands using Wi-Fi via the MAVLink protocol to the ESP32 microcontroller, which is connected and transmits commands to the Ardupilot flight controller, involves creating data packets with a specific structure and sending them via the Wi-Fi module to the flight controller.

5. Conclusion

In conclusion, it can be noted that using the ESP32 Wi-Fi module to transmit commands via the MAVLink protocol to the Ardupilot flight controller is a convenient and efficient way to control unmanned aerial vehicles without the need for specialized remote control devices.

It is also worth noting that the MAVLink protocol is a widely used messaging protocol for controlling unmanned aerial vehicles, which makes its use on the ESP32 microcontroller even more convenient and efficient.

Overall, using the ESP32 Wi-Fi module to transmit commands via the MAVLink protocol to the Ardupilot flight controller is a convenient and economical method of controlling unmanned aerial vehicles.

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UDC 621.316.71

ALGORITHM OF OPERATION FOR THE CONTROL SYSTEM OF BRUSHLESS MOTORS IN UAV

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Аннотация. В данной статье рассмотрен алгоритм работы безлатчикового регулятора бесколлекторных моторов с микроконтроллера. Описаны основные использованием шаги алгоритма, такие как измерение обратной ЭДС, определение положения мотора, расчет ошибки, регулирование скорости и компенсация изменений. Также обсуждаются способы получения данных о моторе, а также фильтры и алгоритмы для компенсации изменений внешних условий. В результате статья предоставляет понимание процесса работы бездатчикового регулятора бесколлекторных моторов.

Ключевые слова: бесколлекторный мотор, бездатчиковый регулятор, микроконтроллер, обратная эдс, положение мотора, регулирование скорости

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Annotation. This article discusses the algorithm of a sensorless controller for brushless motors using a microcontroller. The main steps of the algorithm are described, such as measuring the back electromotive force, determining the position of the motor, calculating the error, regulating the speed, and compensating for changes. The article also discusses ways to obtain data about the motor, as well as filters and algorithms to compensate for changes in external conditions. As a result, the article provides an understanding of the process of operation of a sensorless controller for brushless motors.

Keywords:brushless motor, sensorless regulator, microcontroller, back-EMF, motor position, speed regulation

1. Introduction

Currently, brushless motors are widely used in various devices such as power tools, drones, robots, electric cars, and many others. These motors have many advantages over traditional brushed motors, including higher efficiency, lighter weight, and higher power output. However, to ensure the efficient operation of devices that use brushless motors, it is necessary to have an accurate and reliable speed and direction controller.

This article will examine the algorithm and circuit of a sensorless controller for brushless motors using a microcontroller. Each stage of the algorithm and important aspects such as obtain data on the motor without using sensors, measuring back electromotive force (EMF) principles, determining the rotor position, error calculation, and speed regulation will be described in detail.

2. Problem statement

The problem that this article addresses is the need for accurate and reliable speed and direction control of brushless motors. In order for devices that use brushless motors to operate efficiently, a sensorless controller is required to precisely control the motor.

However, there are several types of controllers, each with its own advantages and disadvantages. For example, some controllers require the use of multiple sensors, which can increase the cost and complexity of the device. Other controllers may be less accurate but simpler to use and set up [3].

The goal of this article is to examine types of controllers for brushless motors and conduct a comparative analysis, identifying the advantages and disadvantages of each. The article will describe the algorithm of operation and the scheme of a sensorless controller for brushless motors using a microcontroller, as well as important aspects.

3. Comparison of analogs

Sensor and sensorless controllers are the two main ways of controlling brushless motors. Both types of controllers have their advantages and disadvantages, and the choice between them depends on the specific task and requirements of the device.

Sensor controllers use sensors such as encoders or Hall sensors to measure the position and speed of the motor rotor. This allows for accurate and stable control of the motor when load or speed changes, making them particularly useful in industrial applications where high control accuracy is required.

However, sensor controllers have some disadvantages, such as a more complex electrical circuit and a higher number of sensors, which increases the cost and complicates the production of the device. In addition, sensors may wear out and require periodic replacement or maintenance.

On the other hand, sensorless controllers use algorithms for sensorless vector field orientation to determine the position and speed of the motor. This allows for accurate and stable control of the motor when load or speed changes without using additional sensors [1].

Sensorless controllers also have several other advantages, such as a simpler electrical circuit and fewer parts, which reduces the cost and simplifies the production of the device. In addition, sensorless controllers do not require sensor replacement or maintenance, making them more reliable and durable.



Pic. 1 – Diagram of a sensorless controller for brushless motors

4. Approachtosolvingtheproblem

To solve the problem of precise and reliable speed and direction control of brushless motors using a sensorless controller, it is necessary to use an algorithm and an electrical circuit that will allow obtaining and processing data on the motor speed and position without using sensors, without significant deterioration of the parameters.

One approach to solving this problem is to use algorithms for detecting the back EMF (electromotive force) of the motor to determine the rotor position and speed. The algorithm is based on measuring the voltage change on each phase of the motor caused by the rotor movement and using this data to determine its speed and position.

One of the most common algorithms is the "sensorless" method [2], which allows measuring the motor speed and position with an accuracy of one degree without using sensors. In this method, the algorithm compares the

motor phase voltage with a certain threshold value to determine the rotor rotation point.



Pic. 2 – Change in motor phase voltage

To implement such an algorithm, a microcontroller is required, which will receive data on the voltage change on each motor phase, and then process this data to determine the rotor speed and position. A control circuit is also required to control the motor speed and direction based on the obtained data [4].

The electrical circuit of the sensorless controller for the brushless motor includes a microcontroller, a set of power transistors that control the motor phases, and a feedback loop that provides measurement of the motor phase voltages. This circuit may also include additional components such as capacitors, resistors, and diodes for electronic component control and protection.

5. Conclusion

In conclusion, it can be noted that a sensorless controller is an effective and promising solution for controlling brushless motors. It has a number of advantages over a sensor-based controller, including a simpler circuit and fewer sensors, which reduces the cost and simplifies device production.

This article presented an approach to solving the problem of precise and reliable speed and direction control of brushless motors using a sensorless controller based on a non-encoder vector field orientation algorithm. The electrical circuit of the device was presented and the algorithm of its operation was described.

Comparative analyses of various types of sensor-based and sensorless controllers for brushless motors were also conducted, their advantages and disadvantages were identified, and the basic principles of operation and settings for each were described. A sensorless controller for brushless motors represents a promising direction in the field of electronics and mechatronics, and its use can lead to improved performance and reliability of devices using brushless motors.

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UDC 621.3 DEVELOPMENT OF AN AUTOMATED LIGHTING SYSTEM

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Аннотация. Рассмотрены возможности интеграции интеллектуального освещения в помещениях IRITS. Представлены предварительные расчеты оптимального режима работы системы и его практическое обоснование.

Ключевые слова: интеллектуальная система освещения, Arduino.

Annotation. The process of integrating intelligent lighting into IRITS premises is considered. The preliminary calculations of the optimal mode of the system operation and its practical substantiation are analyzed.

Keywords: Intelligentlighting system, Arduino.

1. Introduction

During the day, especially in winter, lighting consumes most of the electricity in a building. Also, as a rule, in the evening, people rarely pass

through lit corridors. Intelligent lighting systems can solve the problem by minimizing the electricity consumption of individual lighting elements.

2. The followig highlightsof the research are

1) The preparatory part consisted in studying the layout of the institute (Figure 1) and the lighting sources.

2) Measuring their distance from each other.

3) Calculating the number of sensors required, their distance and location.

4) An algorithm for managing the system are developed.

5) An algorithm for controlling the system are developed.

At the same time, it is necessary to take into account the characteristics of the lamps and the possibility of moving some of the luminaires so that there are coverage zones. (Fig. 2). The work also requires measuring with a luxmeter and checking with the current lighting regulations of the premises.



Figure 1 – Floor plan of the RITS Institute.

The technical part was to choose the component base to work with. It was decided to implement the system on an Arduino board. Using sensors with an infra-red sensing element with a dimming function. The sensor, reacting to a change in the temperature of the space it is monitoring, brings the Atmega328p controller out of standby mode. It switches on the lighting until a person who has entered the sensor's range has left it [1, 2].

A special feature of the selected infrared sensors is that they have their own solid-state relays, allowing them to be installed "in-line" with already installed and operating lighting systems.

A feature of smart lighting is the intersection of Sensor Coverage Zones. That is, a person passing through each Zone will trigger a cycle of turning the sensor on and off.

Figure 2. shows the location of the lamps in enclosure "B" and the lighting areas.



Figure 2. – Positioning of lamps in enclosure "B" and lighting coverage

3. Conclusion

Based on preliminary data, this system can minimize electricity consumption during the dark hours and reduce energy consumption outside school hours, when the number of people in the institute is significantly reduced and therefore the frequency of people walking through the corridors is also reduced.

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UDC 621.3

ZONE LIGHTING CONTROL MODULE IN THE CORRIDORS OF IRITIS

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Аннотация. Изучены возможности интеграции интеллектуальной системы осветительной установки путем развертывания модуля зонального управления. Обозначены результы интеграции в трех выбранных зонах.

Ключевые слова: освещение, зональный модуль, микроконтроллер, Arduino.

Annotation. Opportunities to integrate an intelligence system for the lighting installation by deploying a zonal control module are examined. The results of the integration into three selected zones are stated.

Keywords: lighting, zone module, microcontroller, Arduino.

1. Introduction

Currently, there are many zone lighting control modules on the market. However, a disadvantage of most of them is their price and limited functions. Such as the ability to put the sensor to sleep to reduce power consumption. In consequence of which, the decision was made to implement a zone control module with energy-saving capability.

2. Highlights

The module is based on the Arduino platform, with an Atmega328p microcontroller.

A solid-state relay is wired to the Arduino, which allows the module to be installed in a "break" line of an existing electrical circuit of a lighting system already in operation. It also has a light sensor connected to it, which will put the whole module to work. The Atmega 328p controller is controlled by a personal computer.

Figure 1 shows the module's block diagram.



Fig.1. - Structural schematic diagram of the module.

From an economic perspective, this layout is relatively inexpensive, and, at the same time, performing all the functions assigned to it properly.

The main part of the experiment was performed in three zones (Fig.2).

Two motion sensors have been installed in each zone, with the requirement that the sensors angled against each other at a distance of a couple of meters. Because, a person entering Zone 1, triggers the first motion sensor as soon as one enters the zone thus turning the light on. Then, he keeps moving towards Zone 2, which detects him the moment he approaches the overlapping angle of the two sensors, which allows lights to be turned on at Zone 2 ahead of time. After one leaves a crossing

angle – sensor in Zone 1 runs for an extra ten seconds and then shuts itself down along with the lighting source. Same principle applies to Zone 3 and all following Zones.



Figure 2 – Zone partitioning

3. Conclusion

In summary, the results of the integration have shown an outcome that provides a reason to continue the wide-ranging working format.

There is a possibility to perform strengthening of the device's capacity and the possibility of increasing the coverage area of PIR-sensors. Arduino board, after further investigation, can be upgraded to a higher-capacity board and allowing for a larger amount of sensors to be connected to it.

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UDC 621.37

ACTIVE LOW-PASS FILTER FOR SONAR RECEIVER MICROCHIP ON CMOS 180nm

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Ключевыеслова:фильтр нижних частот (ФНЧ), операционный трансимпедансный усилитель, управляемый ключ.

Annotation. This article presents the results of the development of an active low-pass filter 5th order based on CMOS 180 nm technology in Cadence IC Design System CAD. The developed filter is characterized by a variable cutoff frequency from 6 to 200 kHz in 3 kHz increments and an uneven frequency response in the operating frequency band of no more than 0.1 dB.

Keywords:low-pass filter (LPF), operational transconductance amplifier (OTA), control switch.

Introduction

Filters are a part of many electronic devices. They are used in receivers, sound equipment, etc.

Filters in integral design, to preserve small sizes, are implemented on OTA. OTA converts the input voltage into an output current with a linear conversion factor [2, 3].

The LPF is implemented by connecting several sections of the first or second order, built on the basis of OTA.

The filter cutoff frequency is changed by changing the capacitance of the capacitors included between the OTA in the filter or by changing the steepness of the OTA [1].

Mainpart

The developed OTA contains two differential inputs, one differential output, a common-mode signal control circuit and 6-digit cutoff frequency control circuit [4].

OTA is shown in Figure 1.



Figure 1 -OTA

The circuit controls the cutoff frequency of the LPF (figure 2).



Figure 2 – The cutoff frequency of the LPF

Transistors are connected in parallel in each digit of the switch (Table 1). The width of one transistor is 0.5 um.

Tuble 1. Connecteduransistors				
Switch number	Number of transistors	Total channel width, um		
1	1	0,5		
2	2	1		
3	4	2		
4	8	4		
5	16	8		
6	32	16		

Table 1. - Connected transistors

The total channel width of the OTA output transistor is defined as the sum of the channel widths of all transistors connected in parallel.

By default, (bit combination 0b000000), the channel width of the OTA output transistor is 1 um. This corresponds to a cutoff frequency of 6 kHz (figure 3, a).

With the maximum bit combination 0b111111, the channel width of the OTA output transistor is 32.5 um. This corresponds to a cutoff frequency of 200 kHz (figure 3, b).

With the bit combination 0b010001, the channel width of the OTA output transistor is 9.5 um. This corresponds to a cutoff frequency of 58.3 kHz (figure 3, c).



Figure 3 – Cutoff frequency

This approach allows to change the cutoff frequency of the LPF with a linear step of \approx 3 kHz (figure 4).



Figure 4 – The cutoff frequency of the LPF

The parameters of the LPF are presented in table 2.

1	
Parameter	Value
Supply voltage, V	3—3,6
Operating temperature range, °C	-6085
LFF order	5
LPF Approximation Type	Butterworth
Number of digits of the control code, bit	6
Frequency range, kHz	6—200
Cutoff frequency tuning step, kHz	3
Frequency response unevenness in the operating frequency band, dB,no more	0,1
1dB compression point IP1dB	10,3 dBm1,03 V

Table 2 – The parameters of the LPF

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VERILOG HDL BASED DIGITAL CONTROL UNIT OF SONAR RECEIVER MICROCHIP WITH SPI INTERFACE Alexandr Manko, Dmitriy Zelenkevich

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Аннотация. В статье представлены результаты разработки цифрового блока управления конфигурацией микросхемы приёмника гидроакустических сигналов на основе синтеза VerilogHDL описания. Обмен данными между цифровым блоком управления и внешним устройством осуществляется посредством SPI интерфейса с высоким исходным уровнем сигнала синхронизации (CPOL = 1) в режиме выборки данных по переднему фронту тактовых импульсов (CPHA = 0). Для конфигурации функциональных узлов микросхемы применяются двухбайтные управляющие слова с указанием изменяемого параметра (адреса регистра) и его присваиваемого значения.

Ключевыеслова:Verilog, интерфейс SPI, цифровой блок управления, управление конфигурацией микросхемы.

Annotation. In this article results of the digital control unit for sonar receiver microchip configuration based on Verilog HDL synthesis are presented. Data transfer between the digital control unit and master device is carried out using an SPI interface with a high initial clock signal level (CPOL = 1) and data reading by rising edge of clock signal (CPHA = 0). Two-byte control words consist of variable parameter (register address) and its assigned value are used for configuration of the microchip functional parts.

Keywords: Verilog, SPI interface, digital control unit, microchip configuration.

Introduction

Two-channel sonar receiver microchip at 6—200 kHz band currently being developed consists of a number of functional parts are to be configurable (Fig. 1):

- receive mode switch (RMS) is responsible for microchip operation

mode:

a) echo signals mode — receiving signals that don't have any modulation so it is carried out without frequency down-conversion and used for radiolocation only;

b) quadrature signals mode — receiving signals with quadrature modulation (QAM, QPSK etc.) with down-conversion and I/Q-signals forming;

— programmable attenuator (PrAtt) for flexible adjustment of overall receive path gain whose ratio step is required to be not greater than 1 dB;

— 5th order Batterworth low-pass filter (LPF) for prefiltering and antialiasing purposes with a cut-off frequency step is about 3—4 kHz from 6 to 200 kHz;

— phase-locked loop (PLL) using as a local oscillator (LO) with the same configuration preset as LPF;

— variable gain amplifier (VGA) with gain might be 0, 20, 40 or 60 dB.

Since the mentioned above blocks are need to be digitally controlled from some external master device (might be microcontroller unit or personal computer), the digital control unit (DCU) for these functions is designed.

Notice. The serial transfer of ADC output data via SPI MISO bus is mentioned earlier, but there is a very low limit for signals upper frequency may be able to transferred (not greater than 10 kHz). This value is reasoned by rather long ADC conversion and small SPI clock frequency which is greatly reduce the actual sampling frequency lower than Kotelnikov's value.



Fig. 1 — The block diagram of sonar receiver microchip

Main part

There are different ways of the communication providing between master (MCU or PC) and slave (the microchip). There are several most commonly used and easiest interface bi-directional standards [2, p. 8]:

- 1-Wire with only one data bus which is not capable of multiple slaves serving;

- I2C (inter-integrated circuit) which provides data transfer using only

two data buses (the signal one and the clock one), but for some reasons it is shouldn't be used then the number of masters are 2 or greater;

- SPI (serial peripheral interface) is the most convenient one, so it is used at the microchip.

SPI provides the data transfer using four wires:

— SCLK — clock signal bus;

— MOSI (master out slave in) — serial input of SPI slave;

- MISO (master in slave out) - serial output of SPI slave;

— CS (chip select) — bus with signal which selects one of multiple slaves for current data transfer.

As the DCU don't have to send some data to master, the MISO bus is retired.

The DCU is block consists of digital parts as gates, flip-flops, multiplexers (MUX) etc., so the most convenient way of its design is using Hardware Description Language (HDL), such as Verilog. The digital parts are might be easily synthesized if they are described by some Verilog code structures [1, p. 32].

The block diagram of DCU is shown in Fig. 2.



Fig. 2 — The block diagram of DCU (every block also has a CLK input)

First of all, when using SPI for communication it is likely that the slave receives CLK signal only then CS is active. It might be easily obtained by the follow Verilog description:

assign $clk = cs \parallel clk_ext;$

Shift register is used for conversion of serial input signal to 16-bit parallel binary code. From the point of hardware shift register is 16 asynchronous D-flip-flops connected at series, but it might be described by Verilog as

```
always @(negedge clk) if (!cs) buffer <= {buffer [14:0], data_in};.
```

Each of digitally controlled block has register with a certainly known address for control data keying which is

8-bit asynchronous D-flip-flop with Set and Reset inputs. It can be easily described using Verilog always-block:

always @(negedge clk) if (set) q <= 1; else if (reset) q <= 0; else q <= d;.

Each 1-byte register has a few bits which are used for control data keying:

- RMS has only 2 states, so 1 bit is enough;

— PrAtt should be programmed to 64 states, so it needs $\log_2 64 = 6$ bites;

— LPF needs about $194/3 \approx 65$ states which is might be reduced to 64 states (also 6 bites);

— due to VGA structure, there is 4 wires connected to output and only one of them has to be selected, so it needs 3 bites.

MUX is the block commutates one input bus with one of the multiple output buses depends on data on Ctrl-input. Verilog-description of MUX is case-block with serial checking of each address.

In some cases (e.g. at microchip initiate) data registers are should be reseted to some default state. It can be programmed at some special binary command as 0xFF. Therefore, reset forming block is basically just one 8-AND gate. When the reset forming output is high, each of data register Dflip-flop sets to low- or high-level using Reset or Set inputs, correspondingly.

The default microchip configuration is set to next states:

— echo signal mode — 0x01;

— minimal overall gain:

a) minimal VGA gain — no amplifier stages are used, so the control data is 0x00;

b) maximum PrAtt attenuation ratio — all 6 sections are enabled by 0x3F binary word;

— minimal LPF cut-off frequency — 0x00, so it is 6.3 kHz.

The testbench designed for DCU includes 2 cases of resetting (at the start and at the end), 1 case for every control data register keying and modeling of CS signal come from master device. The results of DCU modeling using testbench are shown in Fig. 3.



Fig. 3 — Timing diagrams of DCU modeling using testbench

Currently, there is in progress designing of the DCU layout using CMOS 180 nm technology. It is carrying out using automatic digital layout synthesis instrument INNOVUS.

The high-frequency commutation noises from DCU are interfering with analog signal paths located at the same chip, so it has to be at least grounded 4 um metal seal ring around DCU layout and about 50 um spacing between DCU and analog layouts. Also, power and ground buses are should be separated to analog and digital ones with using RC or RLC conductive noises filter if possible [3].

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AN INTEGRAL BANDGAP REFERENCE WITH CURRENT REFERENCE FORMING ON CMOS 180 nm

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Аннотация. В статье представлены результаты разработки интегрального совмещённого источника опорного напряжения и опорного тока на основе КМОП 180 нм технологии. По результатам моделирования в САПР CadenceICDesignSystem разработанный опорный источник характеризуется нестабильностью выходного напряжения схемы 0,4 % и коэффициентом подавления нестабильности питания 57 дБ.

Ключевыеслова: источник опорного напряжения, бандгап, опорное напряжения, опорный ток, КМОП.

Annotation. The article presents the results of design of an integral bandgap combined voltage reference and current reference based on CMOS 180 nm technology. According to the simulation results in Cadence IC Design System CAD, the designed bandgap has the output voltage instability 0.4 % and power supply rejection ratio 57 dB.

Keywords: reference voltage source, bandgap, CMOS, reference voltage, reference current.

Introduction

There is a number of radioelectronics devices, which requires for correct operation high-stability reference voltage sources. The most well-known devices there the reference voltage is crucial are:

- measuring devices, which precision depends on reference voltage stability;

- secondary integral power supplies and regulators;

— analog-to-digital converters (ADC) and digital-to-analog converters (DAC), there reference voltage is used as one of the comparator inputs.

The semiconductor technologies with integral Zener diode are very expensive, so another approach for getting reference voltage is used at microchips. The reference voltage source based on bipolar transistor called "Bandgap".

Main part

The simplified bandgap reference voltage (BGR) circuit is shown in Fig. 1. It has two bipolar diode-connected transistors with area ratio N:1.



Fig. 1 — The simplified circuit of BGR

The operation principle of BGR is based on addition of two voltages: the voltage on the directly-biased p-n-junction which is proportional to absolute temperature (PTAT) and the voltage from another element which is complementary to absolute temperature (CTAT) [1, p.19].

The bipolar diode Q1 is used as CTAT element. Voltage from N times larger bipolar Q2 through the R2—R3 divider is PTAT voltage. Both of these voltages are come to differential amplifier which gains them difference to $K \cdot \Delta V$. This difference (or "error") voltage is used for both inputs feedback (positive at In+ and negative at In–) realized by converting it into the current using M1 transistor. Therefore, the output reference voltage is obtained by adding CTAT and PTAT voltages, and if their temperature coefficients are about equal, it will be the constant:

$$V_{REF} = V_{CTAT} + V_{PTAT} \approx const \approx 1.25 \text{ V}.$$



The circuit of the designed BGR voltage and current is shown in Fig. 2.

Fig. 2 — The designed circuit of BGR voltage and current

The designed circuit has a few features:

— M5 is a narrow and long transistors uses for circuit start [2, p. 101];

— Q2's area is larger by 24 than Q1's one (because CMOS technology bipolars have very small hFE gain), so from the point of layout there is Q1 is surrounded by 24 Q2.

- M4 and M13 are used for supplying operating current to the circuit once the BGR output is about V_{REF};

- C0 is Miller's capacitance used for generation stability enhancement;

- M11 is output transistor forming the p-MOS bias for reference 50 uA current;

— as used CMOS 180 nm has no integral CTAT resistors, the R0, R3 and R5 resistances are temperature sensitive, so a number of provision is done:

a) M6 and M20 are cascode circuit used for stabilization;

b) M11's and all current-biased external transistors length are should be not less than 2 um;

c) M8, M9, M7 and M10 width is should be great as possible.

The results of modeling of designed BGR voltage and current are shown in Fig. 3—4.



Fig. 3 — Reference voltage versus temperature in the supply voltage range 3—3.6 V



Fig. 4 — Reference 50 uA current versus temperature in the supply voltage range 3—3.6 V

The rated reference voltage is 1.246 V. It's unstability mainly causes by supply voltage changing and doesn't exceed 0.37 %.

Reference current unstability in worst case is about 3.6 % which is actually too high for current DAC or precision measuring devices, so it has to be improved at future works by some circuit changes, e.g. using different length current-biased pMOS transistors with nMOS diodes.

The power supply ratio (PSR) shows how much V_{REF} depends on the supply voltage and might be obtained so

$$PSR = 20 \lg \left(\frac{V_{REF_2} - V_{REF_1}}{V_{DD_2} - V_{DD_1}} \right) = 20 \lg \left(\frac{1.2486 - 1.2477}{3.6 - 3.3} \right) \approx -57 \text{ dB}.$$

The current consumption is not greater than 70 uA.

The maximum load current is about 2.1 mA is rather enough for smallcurrent microchip operation. If the load current increases to 1 mA, V_{REF} decreasing is less than 1 mV.

The designed BGR performance is summarized in Table 1.

Specification	Value
Technology	CMOS 180 nm
Supply voltage, V	3—3.6
Temperature range, °C	-6085
Reference voltage, V	1.246
V _{REF} unstability, not greater than	4.7 mV0.37 %
Power Supply Ratio, dB	-57
Maximum load current, mA	2.1
V _{REF} decrease caused by load current	700 ppm
increase to 1 mA	0.95 mV
I _{REF} unstability, %, not greater than	3.6
Consumption current, uA	70

Table 1 — Summary of the designed BGR performance

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UDC 681.783.322 CREATION OF A DRONE USING TAILSITTER TECHNOLOGY FOR AERIAL PHOTOGRAPHY IN HARSH WEATHER CONDITIONS

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Аннотация.В статье рассматриваться расширение использования БПЛА в мониторинге и контроле безопасности в задачах, опасных для человека. Особое внимание уделяется проекту создания беспилотного аппарата типа Tailsitter. предназначенного летательного лля аэрофотосъемки больших и протяженных объектов в условиях суровых северных территорий. В статье подробно описывается конструкция типа Tailsitter, ее преимущества и недостатки, а также цель проекта усовершенствование БПЛА путем использования углепластика, для повышения прочности И облегчения конструкции, и систем терморегулирования для оптимальной работы в экстремальных погодных условиях. Чтобы обеспечить удобную и надежную аэросъемку будет разработан программный интерфейс, выводящий информацию о состояние систем беспилотника, Он позволит наиболее адекватно принимать решения оператору или программе, что снизит риски поломки оборудования или даже крушения.

Ключевые слова: Тейлситтер, аэросъемка, БПЛА (беспилотный летательный аппарат), автономный полет, вертикальный взлет и посадка.

Annotation. The article defines the expansion of the use of unmanned aerial vehicles (UAVs) in monitoring and safety control in tasks that are

dangerous for humans. Special attention is given to the project of creating a Tailsitter-type UAV for aerial photography of large and extensive objects in the harsh conditions of northern territories. The article also gives a detailed description of the construction of the Tailsitter, its advantages and disadvantages, and the project's goal of improving UAVs through using carbon fiber composites to increase strength and lightweight of the structure, and temperature control systems for optimal operation in extreme weather conditions. To ensure convenient and reliable aerial photography, a software interface that displays information about the UAV system's status will be developed. It allows the operator or program to make more adequate decisions, reducing the risk of equipment failure or even crashes.

Key words: Tailsitter, aerial photography, UAV (unmanned aero vehicle), Autonomous aerial vehicles, VTOL (vertical take-off and landing).

Relevance

In modern life, technology plays an important role, especially unmanned aerial vehicles. They are widely used in various fields of human life, especially in the field of safety, where they replace humans in dangerous tasks. These devices provide a more reliable way of monitoring and controlling safety, as well as reducing the risk of human losses. Unmanned technologies create new perspectives for scientific research in the study of nature and the preservation of the environment. Unmanned technologies have already become a key tool in various fields, from the military to medicine and transportation.

Drones reduce personnel costs, speed up processes, increase safety and efficiency. They are used for scanning and analyzing vast territories, delivering goods and medical drugs, monitoring agricultural lands, filming movies, and much more. In the future, drones will become an integral part of the infrastructure of cities and expand their possibilities in new fields of application.

The idea of the project

The goal of the project is to create an unmanned aircraft using Tailsitter technology, which is ideal for efficient and fast aerial surveying of large and extensive structures and technical objects. The planned flight range will be 150 kilometers. Carbon fiber reinforced plastic will be used for the aircraft to make it more robust and lightweight to withstand strong loads, thus allowing high-quality equipment and multiple sensors to be installed.

The unmanned aircraft model is being developed for aerial surveying of northern territories of the country, where unprepared drones fail or crash due to severe weather conditions. To solve this problem, the aircraft will have a special thermal regulation system to maintain the necessary conditions for the efficient operation of its electronics. Additionally, a custom software will also be developed to enable autonomous flight along a predetermined trajectory, thus making the aerial surveying process more convenient and safer.

To address the aforementioned issues, a Tailsitter drone is being developed. This is a type of vertical take-off and landing aircraft, where the wings are fixed vertically, resembling a tail. As a result, the drone can take off and land nearly anywhere, and can easily maneuver close to the ground. Launching and landing the drone does not require complex equipment or specially equipped landing pads, which makes its use easier and reduces the cost of aerial surveying. The Tailsitter drone has higher speeds than traditional aircraft, due to the reduced air resistance on the aircraft. However, there are certain drawbacks to such types of aircraft, such as the weakness of the structure and lack of stability in the air, which limit their use, with the main focus being on traditional types of aircraft.

Although the Tailsitter drone is not widely used due to its complex structure and high manufacturing and operating costs, it has been used in military experiments and research, as well as some scientific research projects. However, the Tailsitter concept continues to attract attention from researchers and engineers in the aviation industry and can be used in the future to create innovative aircraft.

The cross-sectional profile of the unmanned aerial vehicle's wing is a flat-convex shape, chosen based on the need to balance between frontal resistance and lift to achieve the necessary flight speed in a timely manner. The optimal option is to use a flat-convex profile in combination with a trapezoidal wing shape in plan. This choice is highly technological and simplifies the wing manufacturing process. To achieve a strictly vertical takeoff under normal conditions and with the least frontal resistance, the wing mounting scheme was chosen as mid-span, with the center of gravity of the unmanned aerial vehicle located as close as possible to the longitudinal axis, making a smooth vertical takeoff feasible. Ribs are used to shape the wing, increasing its rigidity, and allowing for less weight compared to using a completely filled material for the wing [6]. Control surfaces, such as elevons, are integrated into the wing consoles. To ensure reliability and stability in case of malfunctions, the control mechanisms are placed inside the fuselage, enabling the transmission of rotational momentum to the elevons through the use of a cylindrical gear transmission.

In order to achieve maximum efficiency, the design of an unmanned aerial vehicle undergoes simulations taking into account the dimensions of electronic system components, battery size, and camera dimensions for aerial photography. The design of the unmanned aircraft allows for the use of different types of cameras from various manufacturers, enabling the selection of the optimal camera type for a given task, such as high-resolution imaging for constructing a three-dimensional surface model or wide-angle imaging for obtaining an orthophoto with minimal flight time.During the flight of an unmanned aerial vehicle (UAV), significant physical loads are applied, including engine thrust, the weight of the aircraft itself, lift force, and air resistance.

The role of analyzing the structure for strength and stiffness under different loads during the creation and operation of UAVs should not be underestimated. For these purposes, special software packages are usually used, allowing for an analysis of the structure under static (almost unchanged for a long period of time) and dynamic (quickly changing during flight tests) loads. One such software package is Ansys, which has already been used for modeling and analyzing the aerodynamic loads on the wings of a UAV.When developing an unmanned aerial vehicle [4, 5], one of the important aspects is the electronics system and its placement. All calculations and signal processing are carried out on board the UAV, so special attention is paid to the development of a separate module of on-board electronics that supports the operation of all systems on board in order to simplify technical maintenance and ensure more effective operation. This ensures the safety, reliability, and efficiency of the unmanned aircraft. The drone will be created using carbon fiber reinforced polymer (CFRP). CFRP is a composite material consisting of carbon fibers reinforced in a polymer matrix. This material has high strength and stiffness at a low weight, making it ideal for use in the aviation and aerospace industry. It is widely used in the construction of lightweight and strong aircraft, where it can replace traditional materials such as aluminum and steel, reducing the weight of the aircraft and improving its operational characteristics, such as speed and range.

CFRP is used in the production of helicopter rotor blades and in the production of wings for unmanned aerial vehicles. In all of these cases, the use of CFRP allows for the creation of lighter and stronger structures, which in turn increases the efficiency and safety of flights. In the aviation and aerospace industries, this allows for the reduction of structural weight and the improveme

nt of operational characteristics. The future of aviation is linked to the use of this material, which will lead to the creation of more efficient and safer aircraft. In the case of the Tailsitter design, CFRP will allow for the reinforcement of the structure and increased stability of the aircraft in flight.Thermal regulation system is essential for safe operation of onboard electronics and devices in extreme temperature conditions during flights in harsh weather. Unmanned aerial vehicles (UAVs) rely on various methods for thermal regulation, including passive cooling, separate heat sources, thermal insulation, and more.

Heat dissipation systems redirect the heat generated by electronics to cooler areas, such as the aircraft body, through the use of heat pipes within
the UAV. Additionally, thermal insulation helps to reduce heat losses within the UAV and reduces the amount of cooling required. Overall, the thermal regulation system is critical for the stable operation of UAVs. In particular, for UAVs used for aerial photography in low-temperature environments, a thermal regulation system is necessary, and its development requires particular attention. The main function of the developed aircraft is aerial photography [7]. Aerial photography from unmanned aerial vehicles (UAVs) is the process of capturing photographs or video footage using drones. This technology allows images to be obtained from inaccessible locations where traditional methods using helicopters or airplanes are not suitable. Such photography has become possible thanks to the rapid development of drones and specialized cameras [3].

Aircraft can take beautiful photos from high altitudes, showing landscapes, buildings, and other places that would be inaccessible for photography. They can also capture stunning footage and images of landscapes, cities, and other locations from all angles, providing unique highquality shots. In addition, they can be used to create highly accurate maps and 3D models of terrain, necessary for construction, geological and archaeological research, or for infrared photography allowing for the detection of heat emissions, which is useful for detecting heat leaks, searching for people in the dark, and detecting fires. It also allows for gas pipeline analysis to detect leaks. Finally, various equipment can be installed on the aircraft, and the use of carbon fiber materials enables multiple sensors and more accurate cameras can be installed simultaneously.

To make flights as efficient and convenient for the operator as possible, it is necessary to have an interface that is suitable for the characteristics of the aircraft. It should provide ease of use and rational management of a highly complex system. The map should be the main element of the interface, as it provides users with an accurate representation of the UAVs location at a given time. The map should also provide information about flight restrictions, indicate the presence of obstacles, and help the user determine the optimal route.

The effect of atmospheric currents has a significant influence on the positioning of the aircraft, so the interface should show the environment's impact on the aircraft's position in space. Battery charge level data plays an important role, as it helps the operator estimate the approximate flight time and maximum power the aircraft can output relative to the battery's full charge. This is important as high energy and time costs for flight can be the cause of accidents.

The interface should provide the ability to track flights and retain information about previously executed missions. The user should be able to switch between autonomous and manual control of the UAV. Additionally, the interface should allow the control personnel to easily determine the causes of malfunctions and problems. Developing proprietary software is an essential and complex task that requires a significant amount of expertise and time. This stage will be carried out during the aircraft's refinement and the implementation of the temperature regulation system.

To implement autonomous flight by an unmanned aerial vehicle (UAV) along specified points [1], a route in the form of coordinate points that need to be traversed must be defined. Typically, special software is used to configure flight parameters and set point coordinates on a map. GPS navigation is commonly used for autonomous flight along specified points. UAVs acquire information about their location based on data from GPS receivers and can autonomously follow a predetermined route. Various sensors are utilized to ensure flight safety and prevent collisions with other objects along the route.

Conclusion

Various analytical and design activities lasting over 14 months were conducted during scientific research in the field of unmanned aerial vehicles (UAVs) and the development of an innovative Tailsitter model. In order to have a better understanding, different aspects of the construction and operation of the aircraft were studied. Moreover, related fields were analyzed, the application of which could significantly improve the developed drone. Currently, prototype tests are being conducted with subsequent optimization of its aerodynamic characteristics. The use of carbon fiber as the main material will improve the aircraft's performance by increasing its range, flight time, and payload weight. Additionally, a thermal control system is being developed to provide optimal conditions for the drone at low temperatures, which is important for efficient aerial imaging in the northern part of the country. In the future, after completing these tasks and debugging the controlled flight, special software will be developed to allow autonomous flight to targeted points and perform other additional functions.

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IMAGE CONTRAST CORRECTION USING MODIFIED S-SHAPED BRIGHTNESS TRANSFORM

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Аннотация. В статье рассматривается алгоритм коррекции контраста изображений, основанный на использовании модифицированного S-образного преобразования яркости. Приложенный алгоритм предполагает использование средней яркости обрабатываемого изображения в качестве точки перегиба функции преобразования яркости. Показатели степеней функции преобразования коэффициентов рассчитываются учетом заданных с сжатия поддиапазонов больших и малых яркостей. Приводятся выражения для определения количественных параметров преобразования.

Ключевые слова: алгоритм, контраст, обработка изображения.

Annotation. The article discusses an image contrast correction algorithm based on the use of a modified S-shaped brightness transformation. The proposed algorithm assumes the use of the average brightness of the processed image as the inflection point of the brightness transformation function. The exponents of the transformation function are calculated using the specified compression coefficients of the sub-ranges of high and low brightness. Expressions to determine the quantitative parameters of the transformationare given.

Keywords: algorithm, contrast, image processing.

Introduction

Increasing contrast is an important part of the imagevisual quality enhancement. The most common method of increasing contrast is the method of linear contrasting [1], which can be attributed to the methods of pixel-wise transformation of images. The essence of linear contrasting is to match the minimum and maximum brightness of the image with the boundaries of the possible brightness dynamic range.

When solving the problem of increasing the image contrast, non-linear methods of brightness conversion are more effective. However, their use is limitedby the qualitative nature of the choice of conversion parameters, which complicates the automation of processing. The paper proposes a method for increasing the contrast of images by using a pixel-wise transformation with an S-shaped brightness conversion function. In this case, the conversion parameters are selected based on the quantitative analysis of the processed image.

Main part

The pixel-wisetransformation of an image with an S-shaped brightness conversion function T(I) is described by the expression

$$s = T(I) = \begin{cases} \frac{I^{\gamma_i}}{I_0^{\gamma_i - 1}}, & \text{if } 0 \le I < I_0; \\ 1 - \frac{(1 - I)^{\gamma_i}}{(1 - I_0)^{\gamma_i - 1}}, & \text{if } I_0 \le I \le 1, \end{cases}$$

where S — brightness of the processed image; I — brightness of the original image; I_0 — brightness corresponding to the inflection of the conversion function; γ_1, γ_2 — exponents of the transformation function.

The average brightness of the processed image is used as the brightness I_0 in the proposed method. The exponents γ_1, γ_2 are determined based on the boundaries I_{\min}^*, I_{\max}^* of the brightness ranges to be compressed, determined by the cumulative distribution function F(I) of the brightness, and the value of the k_c compression ratio.

An example of the application of the proposed method is shown in Fig.1. The original image with contrast $K_1 = 0.82$ is shown in Fig.1,a.



Fig.1 – The application of the proposed method

As a result of the brightness conversion with the exponents $\gamma_1 = 2,11$ and $\gamma_2 = 2,30$, the dynamic ranges of small and large brightness are compressed twice, and the contrast of the processed image is equal to 1 (Fig.1,b). Fig.1,b shows the dependencies used in image processing: the linear contrast function $T_{TMH}(I)(1)$, the S-shaped brightness conversion function T(I)(2), the histogram of the original image normalized to the maximum value H(I)(3), the histogram of the processed image normalized to the maximum value H(s)(4) and the integral function of the brightness distribution of the original image F(I)(5).

The result of the application of the proposed method is an increase in contrast and an improvement in the visibility of the details of objects in the image.

Conclusions

A method of contrast enhancement based on the use of pixel-wiseimage transformation of with an S-shaped brightness transformation function is proposed. Since the selection of the parameters of the brightness conversion function is carried out on the basis of a quantitative analysis of the processed image, processing can be automated. The proposed method of dynamic range conversion is quite universal and applicable to a wide class of images.

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IMAGE CORRECTION BY MEANS OF POWER-LAW BRIGHTNESS TRANSFORMATION

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Аннотация. В статье рассматривается метод коррекции изображений средствами степенных преобразований яркости. Предлагаемый метод может применяться для коррекции изображений, полученных в условиях недостаточной или избыточной экспозиции. Коррекция осуществляется путем сжатия поддиапазонов яркости изображения, представленных малым числом пикселей. Предложены аналитические выражения для расчета количественных параметров Приводится преобразований яркости. пример применения предлагаемого метода к изображению с недостаточной экспозицией.

Ключевые слова: обработка изображений, экспозиция, коррекция.

Annotation. The article discusses the method of image correction by means of power-law brightness transformations. The proposed method can be used to correct images obtained under conditions of insufficient or excessive exposure. Correction is carried out by compressing sub-ranges of image brightness represented by a small number of pixels. Analytical expressions for calculating quantitative parameters of brightness transformations are given. An example of the application of the proposed method to an image with insufficient exposure is given.

Keywords: image processing, exposure, correction.

Introduction

In digital television systems, the tasks of image exposition correction and increasing contrast, brightness conversion and the dynamic ranges matchingof the images and the reproducing devices often arise [1]. To solve these problems, linear and power-law brightness transformations are often used, which is due to the simplicity and computational efficiency of such transformations. However, the use of power-law transformations is limited to gamma correction and interactive image enhancement. In this case, the choice of the value of the exponent of the brightnesstransform function is based on a qualitative assessment of the image improvement, which makes it difficult to automate the processing.

The paper proposes a method for transforming the dynamic range of images by means of power-law image brightness transformation with the choice of the exponent based on the quantitative analysis of image parameters.

Main part

Power-law transformation of image brightness I with dynamic range $I_{\min} \dots I_{\max}$ into brightness S with dynamic range $s_{\min} \dots s_{\max}$ is described by the expression

$$s = T(I) = \left(\frac{I - I_{\min}}{I_{\max} - I_{\min}}\right)^{\gamma} (s_{\max} - s_{\min}) + s_{\min}$$

Where T(I) is the brightness transformation function; γ is an exponent of transformation.

I and S are normalized to the number of brightness gradations.

When γ is chosen to be greater then 1, the subrange of low brightness is compressed as a result of the power-law transformation; when γ is chosen to be lessthen 1subrange of high brightnessis compressed. When $\gamma = 1$ the above expression describes the function of linear contrasting. To correct a "dark" image (image most of the pixels of which have low brightness), the exponent γ should be chosen to be less than one. To correct a "light" (image most of the pixels of which have a high brightness), the exponent γ should be chosen greater than one.

The proposed method for choosing the exponent is to determine the type of transformation ($\gamma < 1$ or $\gamma > 1$), and specify the brightness subrange to be compressed.

The choice of the type of transformation is carried out according to the following rule

$$\gamma > 1$$
, if $I_{cp} \ge 0.5$;
 $\gamma < 1$, if $I_{cp} < 0.5$,

where I_{cn} is a mean image brightness.

As the brightnesssub-range to be compressed, a brightnesssub-range represented by a small number of image pixels selected to be compressed. To estimate the proportion of pixels that have brightness in a certain subrange, the cumulative distribution function of brightness is used

$$F(I_j) = \sum_{j=1}^{L} p(I_j)$$

where p(I) is the brightness histogram normalized to the number of image pixels.

The value of the cumulative brightness distribution function $_{F(I_j)}$ shows the percentage of pixels with brightness in $_{I_{\min}...I_i}$ range.

Most often "dark" and "light" images contain a small number of pixels with brightness in the sub-ranges of high and low brightness, respectively. The choice of the brightness subrange to be compressed consists in choosing a subrange of low brightness $I_{\min} ... I_{\min}^*$ or high brightness $I_{\max}^* ... I_{\max}$, which corresponds to a small percentage of the total number of pixels. The boundaries I_{\min}^* , I_{\max}^* of such sub - ranges are selected as follows

$$I_{\min}^{*} = I$$
, при $F(I) = \Delta;$
 $I_{\max}^{*} = I$, при $F(I) = 1 - \Delta,$

where Δ is the threshold value that characterizes the percentage of pixels of the image with brightness in the sub—range $I_{\min} \dots I_{\min}^*$ or $I_{\max}^* \dots I_{\max}$.

After selecting the subrange to be compressed, the exponent γ of power-law transformation is determined. To compress the sub-range of low brightness, the γ is calculated by the expression

$$\gamma = \frac{\log \left[\frac{T_{\text{лин}}(I_{\min}^{*})}{k_{c}}\right]}{\log \left[T_{\text{лин}}(I_{\min}^{*})\right]},$$

where k_c is the compression ratio.

To compress the sub -range of high brightness , the exponent $\,\gamma\,$ is calculated by the expression

$$\gamma = \frac{\log \left[T_{_{JHH}} \left(I_{_{max}}^{*} \right) + \left(1 - T_{_{JHH}} \left(I_{_{max}}^{*} \right) \left(1 - 1/k_{_{C}} \right) \right] \right]}{\log \left[T_{_{JHH}} \left(I_{_{max}}^{*} \right) \right]},$$

An example of the proposed methodapplication is shown in Fig.1. The original "dark" image is shown in Fig.1, a. As a result of the brightness transformation with $\gamma < 1$, the dynamic range of high brightness is compressed in $k_c = 2$ times (Fig.1,b). Fig. 1,c shows the linear contrasting function $T_{IIH}(I)$ (1), the power-law brightness transformation function T(I) (2), the histogram of the original image normalized to the maximum value H(I) (3), the histogram normalized to the maximum value of the processed image H(s)(4) and the cumulative brightness distribution function of the original image F(I)(5).

As a result of the transformation of the dynamic range according to the proposed method, due to the reduction of the sub-range of high brightness, the contrast and distinguishability of details of objects with low brightness is increased.



Fig. 1 – An example of the proposed method application with $\Delta = 0,01, k_c = 2$

Conclusions

Thus, the method of image correction by means of power-law brightness transform is proposed. The method compresses the sub-ranges of brightness represented by a small number of pixels. Since the selection of the brightness sub-range to be compressed is carried out on the basis of a quantitative analysis of the brightness cumulative distribution function of the processed image, image processing according to the proposed method can be automated.

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UDC 662.75 THE POSSIBILITY OF USING BIODIESEL FROM WASTED OILS AS DIESEL FUEL

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Аннотация.Работа направлена на сравнение характеристик биодизеля, синтезированного из отработанного масла, полученного с предприятия общественного питания города Томск, и смесей В5, В10, В15, В20 с требованиями, предъявляемыми к товарным дизельным топливам современными стандартами. Работа содержит краткую методику получения биодизельного топлива, результаты определения характеристик полученных образцов и требования, предъявляемые к товарным дизельным топливам современными стандартами. В ходе работы было определено, что смеси состава В5, В10 удовлетворяют требованиям, предъявляемым к зимней марке дизельного топлива, а смеси состава В15 и В20 соответствуют требованиям, предъявляемым к межсезонной марке дизельного топлива.

Ключевые слова:Биодизель, биотопливо, смеси, отработанное масло, дизельное топливо, технические условия, синтез, переэтерификация.

Annotation. The work is aimed at comparing the characteristics of biodiesel synthesized from waste oil, obtained from the catering enterprise of Tomsk, and mixtures B5, B10, B15, B20 with the requirements for commercial diesel fuels by modern standards. The work contains a brief methodology for obtaining biodiesel, the results of determining the characteristics of the samples and the requirements for commercial diesel fuels by modern standards. It was determined that blends of composition B5,

B10 meet the requirements for a winter grade of diesel fuel, and blends of composition B15 and B20 meet the requirements for an inter-seasonal grade of diesel fuel.

Keywords: Biodiesel, biofuels, blends, waste oil, diesel fuel, technical conditions, synthesis, transesterification.

Relevance

Biodiesel was already demonstrated in the 19th century, when the founder of diesel engines, Rudolf Diesel, showed an engine using peanut oil as fuel [10, p. 16].

More than a century later, the global community is increasingly turning its attention to the possibility of switching to renewable energy sources, abstracting from hydrocarbon resources. This is due to limited and impoverished oil deposits, making it more difficult to extract. All these factors lead to an increase in the price of conventional fuels.

The environmental situation is also worth considering. Due to the emission of compounds such as carbon monoxide and carbon dioxide, sulphur dioxide, the greenhouse effect and the depletion of the ozone layer the environment is deteriorating. This is also an important factor for switching to alternative fuels.

One of the solutions to the above problems can be found in the use of alternative fuels. For example, biodiesel, which can be made from various renewable oil crops, such as soy, corn or rapeseed, as well as animal fats and microalgae.

Biodiesel is a fuel consisting of monoalkyl esters of fatty acids obtained from the transesterification reaction by chemical interaction of vegetable oil or animal fats with alcohol.

The purpose of this work is to obtain samples of biodiesel from wasted sunflower oil and diesel blends with different compositions and to compare the characteristics of the obtained samples with the characteristics of diesel fuel, according to USS 305-2013.

Impact of biodiesel on the environment

Carbon dioxide emissions from the use of biodiesel can be higher than for petroleum fuels. However, it must be taken into account that biodiesel is characterised by carbon dioxide cycling due to renewable raw materials. The carbon dioxide emissions are utilised by plants, such as rapeseed, from which the biofuel is derived. So, we can only speak of the emissions of conventional fuels emitted during the rapeseed cultivation stages. These emissions account for around 27 % of diesel emissions [11, p. 183].

Rapeseed oil, by percentage, contains less sulphur than crude oil. Thus, it is important to note that biodiesel contains far fewer sulphur compounds than crude oil fuels.

However, it should also be noted that the emission of nitrogen dioxide is higher with biodiesel compared with diesel, which can lead to acid rain and photochemical smog.

Another negative aspect is that rape, being a very demanding crop, requires an appropriate quality of soil fertility. This leads to an increase in soil fertilisation. Macrofertilisers and microfertilisers contain compounds that promote the growth and development of various plants. Their use in large quantities stimulates the saturation of reservoirs with biogenic materials. This leads to a decrease in the quality of consumed water and disruption of biodiversity.

Obtaining biodiesel samples

To obtain biodiesel in this work used waste oil, obtained from one of the public catering companies of Tomsk.

For biodiesel synthesis the raw material was filtered from food residues. The waste oil was then heated to 45 $^{\circ}$ C with constant stirring. The catalyst for the synthesis was sodium hydroxide. The catalyst was dissolved in ethyl alcohol beforehand. After the oil reached the required temperature, the alcohol solution of the catalyst was introduced into the oil, then the synthesis time of the reaction was noted when the temperature stabilised. The synthesis time in this work was 1 hour.

After the synthesis time, glycerol was added to the resulting reaction mixture for more complete extraction of the formed glycerol. The resulting mixture was placed in a separating funnel for 24 hours for settling. After one day the upper separated phase was removed and the unreacted ethyl alcohol was evaporated at the rotary evaporator under vacuum [1, p. 25]. Thus, the biodiesel was obtained with oil yield of 67,84 % wt.

Further from the obtained biodiesel and winter diesel fuel, purchased at one of the retail gas stations in Tomsk, six investigation samples of the composition were prepared:

- B 100% vol. of biodiesel;
- D 100% vol. of diesel fuel;
- B5 5% vol. of biodiesel and 95% vol. of diesel fuel;
- B10 10% vol. of biodiesel and 90% vol. of biodiesel;
- B15 15 % vol. of biodiesel and 85 % vol. of diesel;
- B20 20 % vol. of biodiesel and 80 % vol. of diesel.

Comparison of characteristics of obtained samples

For the obtained samples, according to the relevant interstate standards, the following characteristics were determined: density at 15 °C [5], kinematic viscosity at 20 °C [2], mass fraction of sulfur [7], fractional composition [6], cloud point [8], pour point [4].

The results are presented in Table 1.

Technical requirements for marketable diesel fuel according to USS 305-2013 Diesel fuel Technical Conditions [3, p. 3] are presented in table 2.

Characteristic	В	D	B5	B10	B15	B20
Density at 15 °C, g/cm ³	0,888	0,826	0,829	0,830	0,838	0,841
Kinematic viscosity at	15,66	3,569 4,428		4 4 2 2 4 2 2 2	5,330	5,477
20 °C, mm ² /s	0			4,000		
Cloud point, °C	-4	-35	-33	-32	-31	-30
Pour point, °C	-9	-61	-58	-55	-53	-48
Mass fraction of sulfur,	. 5	. 5	.5	< 5	. 5	. 5
mg/kg	< 3 < 3		< 5	< 5	< 5	< 5
Fractional composition:						
50 % (by volume) is						
distilled at a		240	256	254	255	259
temperature, °C	-	249				
95 % (by volume) is	_	310	330	296	312	335
distilled at a	-	510	550	270	512	555
temperature, °C						

Table 1 – Characteristics of fuel blends

Table2 – Requirements for commercial diesel fuel

Characteristic	Summer fuel	Inter- season fuel	Winter fuel	Arctic fuel	
Density at 15 °C, g/cm ³ , not more	0,863	0,863	0,843	0,833	
Kinematic viscosity at 20 °C, mm ² /s, not more	3,0-6,0	3,0-6,0	1,8-5,0	1,5-4,0	
Mass fraction of sulfur, mg/kg, not more	500				
Fractional composition:					
50 % (by volume) is distilled at a temperature, °C, not more	280	280	280	255	
95 % (by volume) is distilled at a temperature, °C, not more	360	360	360	360	

Conclusion

Biodiesel has a number of positive and negative aspects. Biodiesel has a positive effect on the environment. Compared to petroleum fuel production, in the life cycle of biodiesel production and use, carbon dioxide and sulphur dioxide emissions are produced by about 80% and 100% less, respectively [9, p. 17]. However, biodiesel has poor frost resistance properties.

According to USS 305-2013 [3] the fuel blends of B5, B10 composition meet the requirements for winter grade diesel fuel according to the studied characteristics. Further increase of biodiesel content leads to increase of kinematic viscosity and density. This makes the B15 and B20 blends fulfil the requirements for the inter-seasonal diesel grade. Also, as the biodiesel content in the blends increases, the resistance of the blend to sub-zero temperatures decreases.

Thus, waste oil can be used to produce biofuels which, when blended with diesel fuels, will have characteristics close to those of winter and offseason diesel grades.

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UDC 621.396.67: 621.396.721 FLAT DIRECTOR ANTENNA BASED ON A FOLDED DIPOLE Mikhail Nevedrov

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Аннотация. В настоящее время при выборе практической реализации отдельных антенн и особенно антенных решёток всё чаще конструкциям. предпочтение отдают высокотехнологичным В частности, благодаря печатной технологии можно не только снизить производственные затраты, но и обеспечить хорошую повторяемость электрических характеристик при тиражировании антенн, что особенно важно для антенных решёток. В докладе исследуется возможность реализации плоской директорной антенны (типа Яги) на основе петлевого вибратора со схемой питания на основе требующей микрополосковой линии, не применения симметрирующего устройства. Работоспособность предложенной конструкции антенны доказывается моделированием в САПР CSTStudioSuite.

Ключевыеслова. директорная антенна, петлевой вибратор, микрополосковая линия, антенна Яги, моделирование, CSTStudioSuite.

Annotation. Currently, when choosing the practical implementation of individual antennas and especially antenna arrays, preference is increasingly given to high-tech designs. In particular, thanks to the printing technology, it is possible not only to reduce production costs, but also to ensure good repeatability of electrical characteristics when replicating antennas, which is especially important for antenna arrays. The report explores the possibility of implementing a flat director antenna (Yagi type) based on a folded dipole antenna with a feeding circuit based on a microstrip line that does not require to use of a balancing device. The operability of the proposed antenna design is proved by modeling in CST Studio Suite CAD. **Keywords:** director antenna, folded dipole, microstrip line, Yagi antenna, simulation, CST Studio Suite.

It is known that a single folded dipole antenna with a shoulder length *l* of about a quarter of the wavelength (half-wave dipole) has an input impedance of about 300 ohms [2, p. 247]. Difficulties to provide matching such an antenna with the coaxial cable having wave impedance ρ_F equal to 75 Ohms is obvious. In addition, it is required to excite a symmetrical dipole by unbalanced feeder, which usually requires a special device. In article [3], a flat folded antenna is proposed, excited by a stepped microstrip line (MSL) laid along one half of the loop. Due to this, both antenna-to-cable matching and the absence of a balancing device were ensured. However, the loop antenna has a weak directivity, therefore, we have investigated the possibility to increase the directivity of a flat antenna by usage the director antenna principle [2, p. 245]: add one reflector and several number of directors to ensure that antenna active impedance is close to 75 ohms, so the MSL can be performed without steps, i. e. having a constant strip width.

For certainty, we choose the decimeter wavelength range (UHF), the television broadcasting frequency band from 470 MHz to 790 MHz [5, p. 431], with middle frequency f_0 630 MHz (the wavelength λ is 476 mm). As a basis, we take an affordable and inexpensive material — foiled fiberglass 1.5 mm thick, with a relative permittivity ε equal to 5.5. For simulation, we chose microwave and antenna design automation system CST Studio Suite [1].

Materials and methods. The modeling strategy had included the development and analyses of a series progressively more complex models. The initial model contained a single planar half-wave folded antenna formed by a foil tape and excited by a 300 Ohms discrete port "Port1". The ratio of the dipole length 2l to the loop width 2b was taken equal to 5, and the foil strip width sl was chosen to be enough for the MSL screen implementation [5, p. 59]: for the selected material having thickness bd, the 75-ohm MSL strip width was about 1 mm, the tape width was equal 7 mm (Fig. 1).



Fig. 1 – Scheme of the loop antenna initial model

As a result of this model analysis and optimization, we have selected the arm length to reach of the input impedance best matching: it was required to shorten the arms by about 10%. The relative bandwidth of the operating frequency δ_F at the level of the voltage standing wave ratio (VSWR) 2.0 was 21%. It was found that in the plane of the antenna, the maximum directivity *D* reaches 2.58 dBi, and the front-to-back ratio (FBR) R_{FR} was about 1 dB. This means that the passive half of the loop contributes to the increase in directivity of the antenna.

To further increase the directivity, a reflector was introduced into the next model in the form of a straight piece of foil tape of the same width. Due to the impact of the loop passive part, the reflector was placed behind it, although this leads to the complication of the antenna excitation device. As a result of the simulation, it was found that due to the resistance introduced by the reflector into the antenna input impedance, the port internal resistance can be reduced to 150 Ohms. The optimal length of the reflector was chosen, which was about 0.4 of the wavelength, and the distance from the edge of the loop to the reflector was about 0.2 of the wavelength. In this case, directivity D was 5.92 dBi, and the FBR R_{FR} was about 14 dB. Relative bandwidth of operating frequencies expectedly decreased to 11%.

Subsequent models contained one, then two reflectors with an internal port resistance of 75 ohms. The best results were obtained at a distance between directors of about 0.2λ .

Microstrip exciting elements were introduced into the final model so that the cable must be connected to the antenna only at the edge of the flat structure. A foil tape between the reflector and the loop, used as an MSL screen, and MSL strips with a characteristic impedance of 75 Ω , laid along the reverse side of the substrate from edges of the structure to the center of the loop passive part, then, under the loop one half to the gap in the loop active part (Fig. 2). The outer conductor of the coaxial cable must be connected to the reflector, and the inner conductor to the MSL strip (point "*Port*" at Fig. 2). The MSL strip is connected to the loop with a metal stub ("*Pin*" point at Fig. 2).





Results. For the flat director antenna model with a microstrip excitation device was obtained frequency dependencies of input impedance active R_{Inp} and reactive X_{Inp} parts (Fig. 3 a) and VSWR (Fig. 3 b). The relative operating frequency band at the VSWR level of 2.0 was about 7%, and at the level of 3.0 it reached to 11%. For clarity, the dependencies are

presented for the ratio F_R of the signal frequency to the average frequency f_0 .



Fig. 3 – Frequency dependencies of the input impedance components (a) and VSWR of the 75 Ohms microstrip input

The model radiation patterns were almost symmetrical, the directivity was reached 7.6 dBi, and the FBR was equal -18.6 dB. The main lobe was 67° wide in the E-plane and 103° wide in the H-plane (Fig. 4).



Fig. 4 – The radiation pattern E-plane (a) and H-plane (b) cuts

Discussion and conclusions. As a result of the simulation, the operability of a flat four-element UHF director antenna based on a folded dipole with a microstrip excitation device in a relative operating frequency band of about 10% was proved. The antenna directivity exceeds 7.5 dB, such level is achieved for known "wire" design Yagi-type antennas having not less than 5-6 elements [5, p. 108, 114].

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UDC61. 621.383 THE USE OF A PHOTOPLETHYSMOGRAM FOR STUDY OF THE BLOOD PRESSURE IN HEALTH MONITORING SYSTEM

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В Аннотация. статье рассмотрено применение фотоплетизмографии для задачи измерения артериального давления портативным устройством в системе мониторинга параметров здоровья. Рассмотрен принцип работы и измеряемые параметры, принятые в оптимальный клинической практике, также вариант а месторасположения датчика на теле человека и параметры оптического излучателя датчика. Сделано предположение о предпочтительности светодиодных применения источников в виде матрицы последовательно переключаемых светодиодов с разными длинами волн. Автор пришел к выводу о необходимости проведения калибровочных мероприятий для обеспечения достаточной точности измерения.

Ключевые слова: Фотоплетизмограмма, артериальное давление, система мониторинга, метод Короткова, здоровье.

Annotation. In the paper, the use of photoplethysmography for the task of measuring blood pressure with a portable device in a health monitoring system is discussed. The principle of operation and measured parameters applicable in clinical practice, as well as the optimal location of the sensor on the human body and the parameters of the optical emitter of the sensor, are considered. The assumption about the preference of using LED sources, in the form of a matrix of sequentially switched LEDs with different wavelengths, is made. It is concluded that calibration measures are necessary to ensure sufficient measurement accuracy.

Keywords:Photoplethysmogram, blood pressure, monitoring system, Korotkoff method, health.

Introduction

Presented in the paper results are anadvancement of the system design for monitoring the health indicators of the clinic's patients, discussed in [14]. In [14] the standard method of noninvasive blood pressure measurement (method of the Korotkov), which is based on the principle of the temporary compression of the artery, followed by a study of the nature of the restoration of blood flow. Thismethodisnooptimalforportableusage. The Korotkov method requires the use of a pump and a valve, the dimensions of which will add an unwanted weight, volume and energy consumption for a device, which is positioned in the monitoring system as portable. Therefore, the measurer as the part of a system needs an optimization study. Thus, this study, related the analysis of the possibility of using the well-known to photoplethysmography method for measuring blood pressure, is an urgent attempt to simplify and improve the design of a portable device for monitoring health indicators.

The main part

1. Theprinciples of measurement of photoplethysmogram

From the studyof a composition of the photoplethysmography signal (Fig. 1), one can see that the constant component of the photoplethysmogram is mainly related to absorption of optical radiation by tissues that do not change their volume. The main contribution to the pulsating component of the photoplethysmogram is made by arterioles (small arteries that immediately precede capillaries in blood channels).



Fig. 1 - Layersofabsorptionofopticalsignalandphotoplethysmogram signal

The volume of these arterioles changes with pulse blood flow, and therefore when an optical signal is passed through areas with arterioles, the photoplethysmography signal will acquire a variable component that carries information about the pulsatile behavior of the arteriole at different moments of time. The analysis of the variable component of the photoplethysmogram allows not only to determine the pulse, but also to calculate the arterial pressure (in relation to the values of expansion and contraction of the arterioles). A distinction can be made between two principles of measuring a photoplethysmogram: one using a signal reflected from a vessel and the other using a signal transmitted through an arterial section of the body. The choice of principle is determined by the accuracy of the measurement and the optimum type of transducer, including the optimum wavelength of radiation. A view of a photoplethysmogram is shown on Figure 2. The appearance of a photoplethysmogram represents the change over time of the volume of a blood vessel due to pulse waves caused by the release of blood from the left ventricle during contraction of the heart muscle (systole phases). During diastole phase (see Figure 2), the heart muscle relaxes and the blood vessels contract.



Fig. 2 – Signalofphotoplethysmogram

Recording of a high amplitude and time resolution of photoplethysmogram signal is a rather complicated task, which is requiring an optimal approach according to several criteria. For example, technical requirements to hardware are determined by physiological and anatomical features of the human body since human tissues are not homogeneous, which affects the pathway and values of attenuation and reflection coefficients of an optical signal [8].

Analysis of changes in attenuation and reflection coefficients of optical signal is a key to determining the processes of blood vessel expansion and contraction, whose coefficients of contraction and expansion are proportional to required parameters of arterial pressure (systolic and diastolic values). The attenuation of the optical signal is due to various reasons, such as absorption process in tissues and vessels, or scattering on inhomogeneities on the change line, as well as reflection from vascular walls and bones. Thus, the attenuation coefficient is an integral parameter and is conditionally linearly related to vascular thickness change parameters (arterial pressure values). Depending on conditions of signal registration (for lumen or reflection) and the place of signal acquisition, the influence of each attenuation cause on the resulting transmission coefficient will be different and. therefore. the photoplethysmogram interpretation should be performed in an adaptive way with calibration according to known methods (Korotkoff method or electrocardiogram).

Currently, there are various hardware-software complexes for assessing the cardiovascular system using the photoplethysmogram, with the focus on software methods to increase the accuracy of recording the parameters of dilation and contraction of blood vessels by increasing the resolution when varying the received optical signal in amplitude and time (frequency) [4, 7, 12]. During periodic diagnostics, a sufficiently accurate measurement of the number of maxima over a period of time, their amplitude and the nature of the change in the incoming (reflected or passed through) signal is made.

Thus, by analyzing the diagnostic signal curve of a photoplethysmogram, the following clinically accepted parameters are determined during blood pressure measurement [4, 6]:

- stiffness index;
- reflection index;
- index of vascular growth (augmentation, amplification), %.

As measurements of these parameters involve random processes of optical signal propagation and hence a set of statistical values, generation of statistically repeatable data requires high resolution as mentioned above. The data obtained can also be used for heart rate analysis (the period of maximums of the photoplethysmogram corresponds to the heart rate).

2. The optimal location of the sensor on the human body

One should consider the application of the photoplethysmography method for a portable blood pressure meter in a health monitoring system. The position on the human body correspond to the way of obtain of photoplethysmography signal, the wavelength of the optical signal.

At present, in different articles, authors propose to use different wavelength ranges of optical radiation using a laser emitter or LED [1-3, 9-11]. As for the principles of measurement, the value of the optical density of the body varies greatly and depends on the human characteristics, his movements and the point of overlap of the sensor block. Therefore, it is not possible to find a position on the human body to achieve the stable values of attenuation and reflection of received signal in the case of multiple installation of sensor (even for the same phase of pulsation of artery).

Therefore, the analysis a photoplethysmography signal mean the study of relative dynamic parameters such as: the amplitude of the oscillations of the received signal, the period of the signal, the spectral characteristics of the signal. From this study, the indexes, which is applicable clinical practice and mentioned above, can beobtained. In addition, thespecialcalibrationprocedures are required.

Photoplethysmogram can be recorded on various parts of the body in which pulsations of the vessel volume are observed, but the choice of location determines the accuracy of measurement and the optimal type of sensor. For example, sensors, which work on reflection principle, can register pulse vibrations from individual sections of large organs or body parts, where the optical signal can practically not pass through.Nevertheless, for the common cases, the sensors, which works on pass through principle, are used. Its can be installed, for example, on the earlobe, finger phalanx, nasal mucosa, etc. In general, to reduce additional interference, a good contact with the surface of the body is required.

Thus, to choose a location of sensor on human body, the following conditions should be taken into account:

Таким образом, для выбора месторасположения следует учитывать следующие условия:

- the effect of the patient's movement on the fit of the sensor and its location relative to the analyzed area of the body with the artery;

— most of the arteries in the chest are located behind the bones, so it is difficult to find a position to receive a photoplethysmography signal to pass through the artery;

— in the central part of the chest, there are aorta extending from the heart, which pump blood with high pressure and, therefore, it is impractical to place a blood pressure sensor on the chest due to the possible "silencing" of the data received by signals from the movements of the aorta.

One should consider different parts of the body in which the arteries are not closed by large organs or the human skeleton.Figure 3 shows a diagram of the location of arteries on torso [12], and on the fig. 4 the arteries on the neck and shoulders [15].A you can see from the figures and also taking into account the conditions above, the optimal position of the sensor (to obtain a photoplethysmography signal) can be near the artery, close to the sedentary bone. For example, near the subclavianartery.

In this case, the sensor can be positioned below the clavicle bone, since a large number of arteries are located above the clavicle, the pulsations of which can create an error in measuring the pulsations of the subclavian artery (seefig. 4).

3. Sensor's selection

One should consider the options for the application of a sensor or sensor matrix to detect photoplethysmography signal for arterial pressure measurement.Source [5] presents a comparison of parameters of an optical transmitter in the form of a laser and an LED from which it can be seen that in terms of resolution and penetration depth the laser is preferable, whereas for low consumption and low cost the LED is better.



Fig. 3 – Arteries on the human torso Fig. 4 – Arteries in the neck and collarbones

Perhaps a matrix of sequentially switched LEDs and special mathematical analysis should be applied to increase the accuracy of the changes. Multiple wavelengths such as 660, 805 and 940 nmare also appropriate.

ruore it comparative parameters of optical emitters							
Parameters	Laser	LED					
Half wavelength width of the	1-0,1 nm	15-20 nm					
emission							
Mean divergence angle	~ 20-30 degrees	20-50 degrees					
Polarization	polarized	fully depolarized					
Coherence of the radiation	coherent	Incoherent					
Minimum spot to which the	0.1 mm	3 mm					
radiation can be focused							
Maximum efficiency of	10 %	3%					
production units							
Maximum power density	200 W/cm2	0,1 volt/cm2					
achievable							
Maximum power per pulse	100 W	100 mW					
Maximum power per pulse	50W	100 mW					
Price	3-100 \$	0,1-1 \$					
Pulse duration	70 ns	100 µs					

Table 1. – Comparative parameters of optical emitters

CONCLUSION

Thus, a photoplethysmogram can be used to measure blood pressure, provided that a preliminary measurement of blood pressure by means of a tonometer or ECG and calibration of the sensors based on the physiological characteristics of the user are carried out before use.

The optimum location for reflectance measurement is below the clavicle, as the area is less mobile, the subclavian artery is in front of the bone and there are no vessels in the subclavian artery, which could have a significant impact on the blood pressure measurement.

Having carried out a comparative analysis between the LED and the laser, the conclution about the preferable use of LED is made. In addition, to increase the accuracy of measurement, the usage a matrix of LEDs was proposed. In addition, the LEDs should be taken with different wavelengths, which will also reduce the measurement error.

In the future, the practical research on measuring blood pressure using the photoplethysmogram, as well as developing measurement and calibration methods for sensors, is planned.

The use of this measurement method will make the clinic's patient health monitoring system more compact and energy-efficient, as the measurement does not require the use of a pump to inflate the cuff and a valve to release air from it as in the sphygmomanometer.

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PROBLEMS OF DIAGNOSTICS OF TECHNICAL CONDITION OF TORSIONAL VIBRATION DAMPERS OF MODERN MARINE DIESEL ENGINES

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Аннотация.В данной статье рассмотрены ключевые проблемы в области диагностики технического состояния демпферов крутильных колебаний судовых дизелей. Проблема демпфирования крутильных колебаний очень важна с точки зрения долговечности И эксплуатационной надежности всего судового машиннодвижительного комплекса. Большая часть судов, которые сейчас эксплуатируются в России, устарела, и идет постепенный процесс их модернизации и замены, что приводит к появлению на смену морально и физическим устаревшим главным двигателям типа Г60, Г70 (6ЧРН 36/45), SKLNVD, 6ЧН18/22, 3Д6 (6ЧН 15/18) и других, новых иностранных дизелей, производства компаний «Wartsila» (Финляндия), «Caterpillar» (США), «Volvo - Penta» (Швеция), «Scania» (Швеция), «HenanDieselEngineIndustryCo., Ltd» (Китай) и т.д., которые имеют в своем составе новые по конструкции демпферы и антивибраторы таких фирм, как «Geislinger» (Германия), «Hasse&Wrede» (Германия), «STE -«Caterpillar» Schwingungstechnik» (Германия), (США), «Holset» (Англия) и т.д. Диагностика пружинно-жидкостных демпферов крутильных колебаний современных дизелей – это новое направление для отечественной морской индустрии и требует пересмотра как технологических процессов работы с таким оборудованием, так и подготовки квалифицированных специалистов. Ключевые проблемы импортозамещения, а также повышения уровня технологического суверенитета страны, затрагивают вопросы не только изготовления отечественных машин, механизмов, установок и оборудований, но и разработки собственных конструкционнометодик расчета их эксплуатационных параметров, включая методику оценки технического состояния объектов и назначения их остаточного ресурса.

Ключевые слова: диагностика технического состояния, демпфер, крутильные колебания, судовые дизели, система мониторинга.

Annotation. This article discusses the key problems in the field of diagnostics of the technical condition of torsional vibration dampers. The problem of damping torsional vibrations of marine diesel shaft lines is very important from the point of view of durability and operational reliability of the entire engine and propulsion complex of the vessel. Most of the vessels that are currently being operated in Russia are outdated and there is a gradual process of their modernization and replacement, which leads to the appearance of morally and physically obsolete main engines such as G60,

G70 (6CHRN 36/45), SKL NVD, 6CHN18/22, 3D6 (6ChN 15/18) and other, new foreign diesel engines, manufactured by the companies "Wartsila" (Finland), "Caterpillar" (USA), "Volvo - Penta" (Sweden), "Scania" (Sweden), "Henan Diesel Engine Industry Co., Ltd" (China), etc., which include new dampers and anti-vibrators of such companies as "Geislinger" (Germany), "Hasse&Wrede" (Germany), "STE - Schwingungstechnik" (Germany), "Caterpillar" (USA), "Holset" (England), etc. Diagnostics of dampers of modern diesel engines is a new direction for the domestic marine industry and requires revision of both technological processes of working with such equipment and training of qualified specialists. The key problems of import substitution, as well as raising the level of technological sovereignty of the country, affect not only the manufacture of domestic machines, mechanisms, installations and equipment, but also the development of their own methods for calculating their structural and operational parameters, including methods for assessing the technical condition of objects and the purpose of their residual resource.

Keywords: problems of diagnostics, technical condition, dampers, torsional vibrations, marine diesel engines.

Introduction

The gradual renewal of the transport fleet in Russia leads to the appearance of vessels with fundamentally new schemes of ship enginepropulsion complexes (hereinafter referred to as MDCs). For example, vessels of the RST25 and RST27 projects (the first vessels were built in 2012) have replaced the traditional Volgoneft mixed-navigation tankers to perform the same tasks, but with much higher maneuverability qualities. If the Volgoneft tankers of projects 1577, 550, 550A had medium-speed NVD engines with direct transmission to the propeller as part of the MDK, then the vessels of projects 19641, RST25, RTS27 and the like have Wartsila main engines with increased rotation speed and power transmission through elastic couplings to the propeller-steering columns. Increasing the maneuverability of vessels of new designs has led to a more complex MDC schemes, and, consequently, to a change in the nature of torsional vibrations that occur during the operation of the "GD - shaft line - propeller" system. For comparison, we present data on the results of calculations of torsional vibrations and torsiography performedby the MTS test center of the Federal State Budgetary Educational Institution ASTU (certificate of approval of RMRS No. 19.70329.141 dated 11.10.2019, certificate of approval of RKO No. 10723 dated 25.11.2022), both for vessels of the Volgoneft type and RST projects. Vessels of the Volgoneft type are characterized by two dangerous resonant forms of torsional vibrations: single-node and double-node. To reduce the motor shape of torsional vibrations on the main engines of

8NVD48AU (8CHNR32/48) vessels of the Volgoneft type of project 550A, silicone dampers of the B-790 type are used, which quite effectively reduce the amplitudes of dangerous torsional vibrations. Vessels of the RST25 and RTS27 projects are already characterized by the presence of six dangerous resonant forms from single-node to six-node. In addition, the MDCs of ships of old designs are characterized by dangerous harmonics of torsional vibrations of the main orders, that is, multiples of the number of cylinders of the main engine, and for MDCs of ships of new designs, harmonics of intermediate orders can also be dangerous, which is associated with the presence of elastic couplings and gearboxes. Thus, the use of silicone dampers can be inefficient in a large range of torsional vibration frequencies, which leads to the need to use spring-liquid dampers both with torsional stiffness of the spring elements, and with linear damping and cooling from lubricating oil coming under pressure from the diesel crankshaft and circulating in the damper. The oil coming from the crankshaft does not lead to the accumulation of wear products and jamming of the elements of the spring-liquid damper, such dampers are repaired by replacing the spring bags, do not require silicone pressing and other operations that are used for silicone dampers.

These facts have led to an increase in the requirements for torsional vibration dampers, and therefore Wartsila 6L20, 9L, in most cases, spring-liquid dampers manufactured by Geislinger (Austria), which have a more complex design than traditional silicone ones, are used on Wartsila 6 L 20, 9 L 20 diesel engines.

The gradual replacement of ships of old designs with new ones leads to the need for shipowners to diagnose the technical condition of two types of dampers – silicone and spring-liquid, which have different designs and operating principles. This raises several problems, the essence of which and a proposal for solving them are further discussed in this article.

1. Methods for diagnosing the technical condition of silicone dampers

Technical diagnostics of silicone dampers implies a non-selective assessment of the technical condition either by torsiography (on average, every 15,000 hours or after the period assigned based on the results of the last torsiography), or after 3000 hours of operation based on the results of the analysis of the quality of the silicone fluid of the carrier (however, this method is not recognized by the Russian Classification Society (hereinafter - RKO)). Technical diagnostics using torsiography is performed by testing laboratories that are accredited by RMRS or (and) RKO, while there are several similar organizations in Russia. Technical equipment designed for torsiography ship MDK, produced by several companies, for example - "Astech Electronics", "Brüel&Kjær", "Siemens" and others, including there

is a recognized Russian development-radio torsiograph RT-660 (FSUE "Krylov State Scientific Center"). To assess the danger of torsional vibrations and assign the remaining life of silicone dampers, there is a method developed by Professor L. V. Efremov, approved by the Russian Maritime Register of Shipping (hereinafter - RMRS) [2], and there is also a similar method for silicone dampers, approved by the RKO [3].

The torsiography procedure on a real vessel, as well as the equipment [4] used by the specialists of the MTS Research Center, are shown in Fig. 1-2.





Figure1. – Torsiography procedure of the ship's MDK, carriedout by MTS IC specialists»

Figure 2. – Operating principle of the Astech Electronics strain gauge system (Great Britain)

Therefore, at present, the problem with technical diagnostics of silicone dampers is associated only with the use of foreign equipment for torsiography, and, accordingly, with its repair, verification and software update.

2. Methods of diagnostics of the technical condition of spring-liquid dampers

The main way to diagnose the technical condition of spring-liquid dampers is a demountable defect detection, which is performed every 12,000-15,000 hours of operation and consists in measuring the gaps between the packages of spring elements and visually inspecting their integrity. Such diagnostics on the territory of the Russian Federation is currently becoming extremely difficult due to economic sanctions and the difficult geopolitical situation in the world. In addition to all this, there are no centers for maintenance and repair of such devices, as well as their specialists. At the moment, we see three ways to solve this problem. The first is the opening of production, maintenance and repair of spring-liquid dampers in Russia. The second is the training of Russian specialists for technical diagnostics of spring-liquid torsional vibration dampers of foreign production in domestic centers, which must be created under the supervision of leading experts in this field and with the participation of supervisory authorities – RMRS and RKO. The third one is the development of a method for non-selective

diagnostics of the technical condition of spring-mechanical dampers with its approval in the RMRS and RKO.

It should be noted that the RMRS and RKO, with a small operating time and due to the difficulty of delivering specialists from damper manufacturers to Russia, allow torsiography to be performed instead of the next collapsible defecation with an assessment of the amplitudes of torsional vibrations and comparing them with those allowed according to the RMRS or RKO Rules.

The most typical causes of failures of spring-liquid torsional vibration dampers are: wear of spring elements and grooves in the damper housing for their placement; deformation of spring elements; deterioration of oil quality; depressurization of the damper housing.

An example of the process of dismantling, replacing and diagnosing the Geislinger mechanical torsional vibration damper of the MAK 6M25 marine diesel engine of the «Jabrail» vessel (Azerbaijan) is shown in Fig. 3-4.



Figure 3.– Assessment of gaps in the spring elements of the damper



Figure 4. – Detected defects in the surfaces of the damper elements

As it can be seen from these figures, the process requires appropriate equipment and competent specialists, but is carried out directly on the ship.

3. Transition from periodic technical diagnostics to continuous monitoring

Periodic torsiography and assessment of the technical condition of torsional vibration dampers, however, is not a firm guarantee of the absence of dampers' failures during the inter-inspection period. This is confirmed by the presence of accidents of the ship's MDK, the main cause of which was fatigue failure of diesel crankshafts, intermediate and propeller shafts, gearboxes, couplings and other elements. Examples include breakdowns of the MDC elements of the following vessels: the OTA-974 tug in 2005; the Arater cargo and passenger ferry in 2013 [5]; and the Lady Gertrude fishing vessels in 2016 [7] and Ben & Casey in 2017 [8]; tanker ELAND in 2019 [1], tug OT-2110 in 2022, etc. The described cases resulted in financial losses for shipowners ranging from several million to several tens of millions of rubles. These examples indicate that there is insufficient guarantee of risk reduction when using periodic torsional vibration monitoring and the need to switch to

their constant monitoring using specially designed systems. The main parameters that these systems should control are: the amplitude of torsional vibrations or shear stresses in the shafts; the temperature of the elastic coupling, if any; and the frequency of resonant vibrations. Based on the analysis of these parameters of torsional vibrations, conclusions can be drawn about the danger of operating torsional vibrations and the technical condition of the damper.

Such a system on ships is still used serially only by Geislinger (Austria) [6] together with torsional vibration dampers manufactured by the same company. The concept of a torsional vibration monitoring system developed by specialists of the Water Transport Operation Department of ASTU is shown in Figure 5.



Figure 5. - Torsional vibration monitoring system concept

Monitoring of torsional vibration parameters on the ship provides the following capabilities: measurement of torsional vibrations, surface temperature of the elastic coupling, shaft speed; calculation of additional parameters to translate the measured parameters into angular amplitudes or tangential stresses in the shaft; comparison of the obtained values with the permissible ones; formation of audio and visual alarms when the permissible values are exceeded; recording, storage and transmission information.

Technical diagnostics of the condition of the ship's MDK elements is performed in the technical service of the shipowner with the possibility of additional control by specialists of the system manufacturer. The reasons for this separation are as follows: detailed data analysis requires time, a highly qualified specialist, and computing power that is not available in the central measurement unit of the system on the ship.

It should be noted that this separation of functions is also typical for the MK6 monitoring system from Geislinger [6], the concept of which is shown in Figure 6.



Figure 6. – Concept of the Geislinger torsional vibration monitoring system

The adopted concept allows you to separate the functions of the system and, accordingly, provide for a phased development of its development from the concept to the finished product.

Despite all the above, the shipowner is not obliged to switch to a new type of assessment of the technical condition of the ship's MDK using monitoring systems until this approach is scientifically and economically justified and in the absence of an effective technical solution approved by the RMRS and RKO.

Conclusions:

1) The key problems of import substitution, as well as increasing the level of technological sovereignty of Russia, affect not only the manufacture of domestic machines, mechanisms, installations and equipment, but also the development of own methods for calculating their structural and operational parameters, including methods for assessing the technical condition of objects and assigning their remaining resource to the emergency state.

2) The method of non-selective diagnostics is part of a big problem of technological sovereignty of Russia in the field of design, operation and repair of spring-liquid dampers for torsional vibrations of marine diesel engines;

3) Currently, marine diesel engines with both silicone and spring-liquid torsional vibration dampers are in operation on ships, which differ in design and methods for diagnosing technical condition;

4) The installation of special torsional vibration monitoring systems can reduce the risks of dangerous torsional vibrations during the inter-inspection period of evaluating the technical condition of the damper;

5) Diagnostics of the technical condition of spring-liquid torsional vibration dampers is a new direction for the domestic marine industry and requires revision of both the technological processes of working with such equipment and the training of qualified specialists.

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SHIP'S VENTILATION SYSTEM

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Аннотация. Описывается система вентиляции на судне. Перечислены принципы действия разных видов вентиляции. В заключении рассмотрены их конструктивные особенности их применение. Ключевые слова: система судовой вентиляции, вентиляция, Вентиляционные устройства, электрооборудования.

Annotation. The ventilation system on board is described. The principles of operation of different types of ventilation are listed. In conclusion, their design features and their application are considered.

Keywords: Ship ventilation system, ventilation, ventilation devices, electrical equipment.

Introduction. A modern ship is a complex engineering structure. Different types of equipment, mechanisms and systems are installed on any ship, "regardless of its purpose - timber carrier, trawler, tanker, passenger, dry cargo, research, etc. along with the power plant" [1, p. 87]. The task of that equipment is to provide maximum automation of all production processes, "optimal working conditions for the crew on board and solving other special issues" [1, p. 87].

"In order to prevent overheating and air pollution by various harmful substances, the premises on the ship are equipped with effective ventilation. Mechanisms and systems, heat, moisture, toxic, flammable and explosive gases are released into the volume of the premises during the operation of the vessel from equipment" [1, p. 30].

It goes without saying that the ship's ventilation system has "to replace polluted air with fresh air; maintain the desired temperature with a given regime; lower the temperature to normal" [2, p. 372]. Specially equipped premises are required to accommodate the crew, transported goods, passengers, store materials and food supplies.

"Toward net zero emissions by 2050, efficient renewable energy systems and various energy interactions are increasingly proposed to improve energy matching and flexibility capacities. The existing studies primarily focused on onshore solar and wind energy sources, which can interact with electric vehicles or static batteries to improve the economic performance by the energy flexibility control" [5, p. 13438].

Numerical investigation on the resistance characteristics of a flying boat planing in calm water were studied byYang Guo, Dongli Ma, Muqing Yang, Haode Hu, Xing'an Liu [5]. I.U. Vakarelski, F. Kamoliddinov, A. Jetly, S.T. Thoroddsen consideredventilated cavitation and splashing effects in hydrofoil and speed-boat models tests [8]. X. Guo,H.Luo, S.Cao, Y. L. Gao, K. Pan researched the issues of the techno-economic flexibility investigation and enhancement for the hybrid ocean-energy supported zeroenergy building and seawater-transportation system [6].

The main part. The ship's ventilation system "protect the premises from the penetration of harmful, bad-smelling and explosive gases from the surrounding space; remove gases emitted by instruments and apparatus, as well as liquid and solid fuels; freshen the air in the cargo holds to preserve the transported products and cargo" [3, p. 32]. "The ventilation system is designed to create in premises (not equipped with air conditioning systems) the specified qualities of the air environment (in terms of temperature, gas composition and mobility) that meet sanitary standards. On the other hand, the ventilation system regulates air exchange in all ship spaces, including those where equipment, mechanisms or systems are located, the operation of which is associated with fire, biological and other hazards" [1, 23].

A network of special pipelines with fittings, mechanisms, devices that provide normal ventilation of the premises is called the ship ventilation system [7].Clean air is taken from the atmosphere, during ventilation. Ventilation depends on the principle of operation. It can be natural, artificialand anti-chemical ventilation. Correct ventilation can keep cargo in good condition in the great majority of circumstances if properly employed. In all cases, the ventilation system must ensure safe and trouble-free operation in the premises(Figure 1).



Figure 1 – Ventilation system on the ship

More recent developments in ventilating systems have led to air being predried before entering the hold. The temperature of the air may be controlled before entering the compartment. This artificial or forced ventilation, has become increasingly popular. While properly used, it can prevent any sweat damage to cargo. Heated or polluted air enters the exhaust ventilation grids on pipelines in artificial exhaust ventilation that is laid throughout the room and removed outside through air exhaust devices in the separation from and air conditioning systems.

The anti-chemical ventilation system stands out as a special independent group from the general ship ventilation system as well. "It serves to create the necessary qualities of the air environment (in terms of gas composition, mobility and exchange) and to provide excessive backwater in the serviced pressurized premises if it is necessary to protect the ship from biological weapons, radioactive fallout and toxic substances" [1, p. 56].

Air exchange is carried out due to the difference in densities of cold outdoor air and warm indoor air with natural ventilation, as well as due to the energy of air movement. In this case, air is taken into the compartment through a deflector. If the deflector is installed with a hole in the opposite direction, then it will be in the zone of rarefaction of air and will work as an exhaust fan [1]. In natural ventilation method, fans may be incorporated into cowl ventilator system. Cowls may be installed with manually operated closure flaps.

The effectiveness of natural ventilation depends on the weather and season [1]."Natural supply or removal of air from the premises is carried out through direct-flow pipelines using ejection or deflector heads, mushroom heads and gas-tight covers installed on open decks" [1, p. 11]. The process of natural ventilation is carried out by means of using the force of the wind or air currents (wind pressure). The principle of supply ventilation operation is that the fan creates a vacuum, and on the outlet pressure. Fresh air enters through the air duct to the electric fan. Air is directed through the sockets along the suction duct to the atmosphere since a vacuum is created at the suction pipe of the electric fan during its operation [4].

Air exchange in the room is carried out naturally due to the difference in the specific gravity of warm and cold air or due to the energy of the movement of the air surrounding the ship (Figure 2). The ejection head is used to extract polluted air, so it is installed with a cone in the direction of the vessel [4].

If the devices and equipment installed in the room emit harmful substances, then ventilation is carried out through the connecting pipes. "Ventilation can be autonomous or combined with a common exhaust ventilation system depending on the nature and time of operation of the devices. The air flow to the instruments and equipment is carried out either from the room or from the outside" [1, p.34].



Figure 2 – Ventilation devices: a - deflector; b - ejection head 1 - stopper; 2 - fresh air; 3 - pipe; 4 - hole with mesh; 5 - ejector; 6 - input cone; 7 - deck; 8 - polluted air

Natural ventilation is unstable, characterized by dependence on weather conditions. Natural circulation is of limited use, despite the device simplicity [1].
The artificial ventilation system consists of:

- air ducts with uncoupling dampers,

– fans,

– intake and air distribution fittings.

Reliable operation of the ventilation system can only be ensured with the correct position of the deflector in relation to the wind and with sufficient protection against water ingress.

The process of ventilation system provides the required quality air due to the elimination of polluted air. In addition, it is designed to supply air to mechanisms, boilers, electrical equipment and systems that consume air during operation.

Thus, the principle of operation of ship ventilation systems is to provide fresh air. The specified air exchange is carried out naturally or artificially through a network of pipelines.

Conclusion. Sufficiently powerful and developed ventilation systems are designed on a modern marine vessel. The ship's ventilation system replaces polluted air with fresh air. The effectiveness of natural ventilation is affected by the weather and season, so it may not always provide the required number of air changes in the room. The process of natural ventilation is characterized by large dimensions. The ventilation system ensures a normal atmosphere in ship spaces by removing polluted air and replacing it with fresh air. Natural circulation is of limited use despite the simplicity of the device, the absence of the need for mechanical energy and the low cost on modern ships. More reliable artificial ventilation of rooms is most often used on sea transport ships, which makes it possible to supply air to the room.

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WIRELESS ENERGY TRANSFERRING USING MICROSTRIP LINES

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Аннотация.Был проведен эксперимент по передаче энергии между двумя параллельными прямоугольными микрополосковыми спиральками в диапазоне частот от 140 до 300 МГц. Расстояние между спиралями управлялось путем измерения коэффициента стоячей волны (КСВ). Исследование показало, что потери энергии не падают ниже 1 дБ при изменении расстояния между спиральками в диапазоне от 5 до 17 мм. Моделирование, проведенное на основе результатов эксперимента, подтвердило этот вывод. Ключевые слова: микрополосковая линия, прямоугольная спираль, беспроводная передача энергии, расстояние между структурами, коэффициент стоячей волны.

Annotation.The transfer of energy between two parallelarranged rectangular microstrip spirals in the rangefrequencies 140-300 MHz. Control of change of distance between linescarried out by measuring the SWR. The simulation results showed that energy loss does not decrease below 1 dB when changing the distance betweenspirals in the range from 5 to 17 mm

Keywords: microstrip line, rectangular helix, wireless power transmission, distance between structures, standing wave ratio

New mobile devices can be charged wirelessly thanks to the Qi standard. However, this method has a limited range and works effectively only when the flat coils are in full contact, and at a distance of 3-5 mm, the energy transfer is significantly reduced. Another method, based on magnetic resonance, has a large area of effect, but its effect on people and living beings in the vicinity has not yet been studied. There is also a method of power transfer using coupled strip lines, however it has directional power transfer with crosstalk. The use of coupled resonators is also inefficient, since their quality factor is inversely proportional to the bandwidth.

The main purpose of this work is to improve the parameters of the power transmission system associated with the mutual displacement of its elements. reception and emission described in the above-mentioned works. To increase the offset shift distance, the length of the microstrip line was increased. The spiral line was extended to the inside. This addition made it possible to increase the offset shift distance to the values of half of the linear dimensions of the structure itself, of course, with certain losses in the energy transfer coefficient. The main reason for the need to improve the transmission parameters is to increase the power of the system. The task was to check the so-called scalability of the system. At In this case, the power of the system was determined by the battery charging time. Time charging time was set to 30 min. Based on these characteristics, as well as the parameters of the battery capacity, the value of the transmitted power of the wireless power transmission system was determined. This value was units of kilowatts. For definiteness, we will use the value of 1 kW. Based on this, the previously proposed electromagnetic structure, used for the wireless power transmission system has been upgraded. The width of the line, and, accordingly, the gap between the lines of the spiral was increased to 70 mm. The thickness of the dielectric substrate at this was increased to 20 mm. At the same time, the physical parameters were calculated in such a way as to reduce the operating frequency of the system, which would simplify the implementation of the rectifier unit, with taking into account the increase in the working distance of energy transmission. Structure appearance in AWR Design modeling Environment Microwave office is shown in fig. 1. Studies have been carried out for two distances and at lower frequencies (less than 100 MHz).

Using the proposed configuration also implies increase in the length of the microstrip line in comparison with the proposed previously. In this embodiment, the length of the microstrip line of the electromagnetic structure was approximately 11 m. element of the power transmission system were: the length was equal to 1250 mm, width - 1190 mm. Accordingly, the working area of the electromagnetic structure was approximately 1.4 m². This value was chosen based on the known universal applicability of the system.



Fig 1 – Design modeling Environment Microwave office

It was also planned to use this wireless power transmission system to recharge the batteries of urban electric vehicles. In this case, one element of the system was installed under the bottom of the vehicle body, the other was built into the roadway.

Based on the results of the research, a table was compiled (Fig. 2), showing the obtained dependencies indicating the maximum transmission coefficients depending on the operating frequency of the system.

↓ ↓ ↓	0 мм	140 мм	280 мм	480 мм	620 мм
170 мм	81 МГц	81 МГц	81 МГц	73 М Гц	73 МГц
	-1.747 дБ	-4.331 дБ	–9.1 дБ	-12.57 дБ	-11.3 дБ
200 мм	81 МГц	81 МГц	81 МГц	73 М Гц	73 МГц
	-3.3 дБ	-5.9 дБ	–11.17 дБ	-14.5 дБ	-12.58 дБ

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During the research presented in the article, computer models of microstrip structures suitable for recharging batteries of both UAVs and autonomous urban electric vehicles have been developed. The values of the energy transfer coefficient obtained as a result of the conducted studies at the corresponding frequencies indicate that the wireless transmission system energy presented earlier is fully scalable.

A simple increase in the geometric dimensions of electromagnetic structures leads to an increase in the value of the transmitted power and an increase in the maximum working distance of the power transmission system with increased possible shifts of the electromagnetic structures of the system. It can also be concluded that the losses associated with the process wireless power transmissions are acceptable when using the described elements of the system. The limit values for the distances between the elements of the power transmission system were taken based on the maximum clearance electric vehicle.

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UDC 631.589.2 SOFTWARE AND HARDWARE COMPLEX FOR GROWING PLANTS AT HOME BY THE METHOD OF HYDROPONICS

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1. Introduction

Usually, when growing plants at home, a low-productivity method of planting plants in the ground is used [2]. This method requires constant attention to the plant throughout their growth. The plant is highly susceptible to diseases and parasites, which are difficult to get rid of without damaging the plant itself, since these diseases and parasites are highly likely to remain in the soil, from where they can be removed only with strong chemicals. It is also necessary to accurately monitor the frequency of adding fertilizers to the plant and the amount of nutrient mixture so that the roots do not get a chemical burn, and plant transplantation is a process that poses a threat to the entire plant.

There is a method of planting some plants in a container with water with a nutrient mixture [5], according to which the plant receives the necessary nutrients and an aqueous solution. However, with this method, frequent water replacement is required to prevent mold formation and root rot. But, when replacing water, replacement of fertilizers is also required, which, with such regularity of this process, carries a great risk in case of an error with the amount of the mixture. Also, with this method, the root system of the plant often turns out to be unstable due to the lack of support.

An effective method with minimal risks for the plant is the hydroponics method. However, the vast majority of modern devices based on hydroponics are designed for use in industry [5], which does not allow them to be used at home for reasons of size, inconvenient management and the need for manual control of fertilizer irrigation parameters and plant condition, as well as an ill-conceived aesthetic component.

There are models of hydroponics adapted to placement at home [3], but they also, like industrial hydroponics, require completely manual fertilization, control of irrigation parameters, do not have built-in lighting, and control of the plant condition is carried out manually, using various testers that require a long time for measurements.

2. Problemstatement

Based on the analysis carried out, a device for home cultivation of plants was developed, devoid of the disadvantages of existing analogues.

For greater user convenience and increased efficiency, the concept of a desktop device based on the principle of hydroponics was developed. The principle of hydroponics is based on growing plants without soil, in which case they get the necessary substances from an aqueous solution.

This method allows you to more effectively saturate the roots with an air mixture and prevents them from rotting. All the necessary substances from fertilizers are absorbed by the plant, nothing settles in the ground. The probability of parasites appearing is significantly reduced, and if they appear, it will be easier to get rid of them, since there is no soil in which they can survive the effects of plant treatment methods. Also, the method of use is devoid of the need to replace the soil.

The device described in this article, due to the absence of the disadvantages listed above, can be placed on a desktop, window sill and any similar horizontal surface. Also, to manage and assist in the maintenance of this hydroponic system, it is supposed to use a functional application

connected to it via the Internet. The user can control the regularity and intensity of irrigation, fertilizer supply and lighting from anywhere in the world, where there is access to the global network, as well as receive data from sensors of temperature, air humidity, root humidity, illumination and carbon dioxide. The application will also allow you to manually configure or select from existing templates of the system's response to changes in parameters received from sensors.

3. Approach to solving the problem

When solving this problem, the Internet of things (IoT) paradigm was used, which involves not only connecting things to the Internet, but also building a digital copy of them. This will allow you to control the growth of the plant, based on data collected from sensors used in the device, which in turn reduces human participation in growing the plant to a minimum.

The roots of plants need not only water and minerals dissolved in it, but also air. For greater efficiency of the supply of the necessary substances, it was decided to use the principle of periodic flooding, which, unlike planting plants in the ground, allows not only to monitor the condition of the root system, but also to control the indicators that affect plant growth.



Fig. 1 – Generalized structure of hydroponics

To implement Internet connection and data collection from sensors, as well as for primary data processing, it was proposed to use a microcontroller from Espressif Systems of the esp32 model. The choice of this model is due to the fact that it has a built-in Wi-Fi interface, which allows you to simply communicate with a mobile application on a local network and over the Internet, as well as sufficient performance of the computing core and the availability of all the necessary data buses to communicate with sensors.

As an interface through which you can monitor the parameters of the device and the environment, as well as set settings for the described device, the project uses a mobile application. To write the application, a framework for the C# language called "Xamarin Forms" from Microsoft is used. This framework was chosen due to the modern and supported C# language, as well as the simple porting of the application to other systems. The application implements the addition of new devices, monitoring of external and internal parameters, setting the frequency of watering and the time of illumination, a

reminder of the change of water with fertilizer, which allows you to effectively grow the planted crop.

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Fig. 2 – Application interface

It is necessary to efficiently and quickly transfer data over the Internet, but common technologies such as http and https are not suitable for use in microcontroller-based devices due to their complexity and significant load on the computing core. For use, it is proposed to use the open Message Queue Telemetry Transport (MQTT) protocol [4], which is devoid of these disadvantages. This protocol is based on the Publisher – Broker (Server) – Subscriber system, which allows you to build an efficient data exchange structure between devices.



Fig. 3 – Protocol structure MQTT

Before connecting to a Wi-Fi network, the device has no connection to the Internet, therefore, to the MQTT broker. In such cases, the device will distribute the Internet and during the initial settings will become a local MQTT broker, with a stable IP address in the local network. If the Internet is disconnected or it is not possible to connect to a Wi-Fi network, a similar process will occur, except for the mandatory transfer of settings [1].

When building a digital copy of the device, information collected from sensors is needed. Sensors collect data about 3 significant parts of the device:

1. Environment (Air temperature, humidity, amount of carbon dioxide)

2. Root system (Ambient temperature, ambient humidity, Medium acidity index)

3. Nutrient solution (Temperature, Acidity index).

Based on the data obtained, a digital copy of the device is being built, which allows not only to efficiently dose the intake of nutrients, but also to

more accurately predict the time before replacing the nutrient solution, and to signal an unacceptable environment for growing a particular crop.

4. Construction

Due to the use of the device in the home environment, when designing the device housing, not only the task of maximizing the efficiency of crop growth was set, but also a set of shapes and sizes allowing the device to be placed on a table, window sill and other surfaces. A model with 3 main parts was developed: A sub-floor with electronics, a central part for storing nutrient solution and a main pot for growing crops.



Fig. 4 – Block diagram of the device

To build prototypes of the device, a 3d printer based on layer-by-layer application of plastic was used, this method has many advantages, such as: simplicity of prototyping and manufacturing accuracy, but there is also a significant drawback due to the method of constructing the model, cracks form between the layers, which affects the tightness of the device, to solve this problem it is supposed to cover the inner walls with thin a layer of epoxy resin.



5. Conclusion

In the course of the developments presented in this article, a digital model of a device designed to ensure the vital activity of plants in a room environment was developed. The resulting device showed significant advantages in the autonomy and quality of plant growth in comparison with existing analogues. The use of the principles of hydroponics made it possible to deliver the necessary nutrients to the plant more efficiently and in a more controlled manner. The addition of a microcontroller to the circuit freed the user from the need for monitoring and regular care of the plant. From the moment of planting the plant and before harvesting, the user is required to change the water in the device only once every 2-3 weeks and pour fertilizers into a special tank 2-4 times a year. The microcontroller collects and analyzes data from various sensors around the clock, automatically calculates irrigation, fertilizer and lighting parameters based on the settings. Also, the use of the Wi-Fi module has significantly increased the comfort of using the device, allowing you to configure it and receive data about the plant through a mobile application anywhere in the world where there is Internet access.

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DOSIMETER BASED ON SBM-20 GEIGER-MULLER COUNTER AND ARDUINO NANO

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Аннотация. В статье представлен дозиметр, выполненный на основе счётчика Гейгера-МюллераСБМ-20. Для обработки данных с трубки используется отладочная плата ArduinoNano. Дозиметр способен измерять β и γ излучение интенсивностью от 14,4 мкР/ч до 144 мкР/ч. Данные выводятся на дисплей 1602, для управления используются 2 кнопки.

Ключевые слова: дозиметр, ArduinoNano, микроконтроллер, счётчик Гейгера-Мюллера.

Annotation. The article presents a dosimeter based on the Geiger-Muller counter SBM-20. Pulses from SBM-20 tube are processing by Arduino Nano debugging board. The dosimeter is capable of measuring β and γ radiation with intensity from 14.4 μ R/h to 144 μ R/h. Dosimeter has 1602 display to show measured radiation and 2 buttons which are used for control.

Keywords: radiometer, Arduino Nano, microcontroller, Geiger-Muller counter.

Introduction

Dosimeter is the devise to measure intensity of radiation and dose of radiation. The first dosimeters had sound indication of radiation by speaker. This method allowed only to assess the presence of radioactive contamination and to estimate approximately how dangerous the radiation level is, for a numerical assessment of radioactivity, arrow devices appeared, with which it was already possible to measure the level of ionizing radiation.

With the advent of digital technologies, the role of measuring and calculating the radiation value has shifted to the microcontroller. Digital dosimeters have greater accuracy compared to arrow ones.

Main Part

As the microcontroller (MC) was decided to use Arduino Nano board with ATMega32u4 [1] microcontroller. The radiation sensor is the SBM-20 [2] Geiger-Muller counter, this sensor can register β and γ radiation, its sensitivity ranges from 60 imp/mkR to 75 imp/mkR, the maximum counting speed is 4000 imp/s. The pulses will be registered using hardware interrupts on the D2 pin of the microcontroller.

1602 display is used to show measured and calculated data, display can be connected directly to the MC board, or it is also possible to connect the display via an I2C converter. Also dosimeter has two buttons to operate the device and piezo buzzer for sound indication of radiation. It is planned to use the 18650 battery for power supply, but SBM-20 counter needs 400-volt DC power supply, so it is necessary to make a circuit of a step-up DC/DC converter. The step-up converter can be made on a blocking generator circuit, or on a ready-made board of a step-up converter up to 400 volts.

The tube is powered by a high voltage through a load resistor with a 5 MOhm resistance value. The pulses from the sensor have an amplitude more than 50 V, such a high voltage is dangerous for the microcontroller, therefore it is necessary to use a pulse amplitude reduction circuit. This unit can be implemented using a transistor switch, which, when a high voltage pulse appears, will supply a voltage of 5 volts to the digital output of the microcontroller.

The structure diagram of the dosimeter is shown in Fig. 1.



Fig. 1 — Structure diagram of the dosimeter

The program code is written in the Arduino programming language in the Arduino IDE development environment. The "LiquidCrystal" library is used for controlling 1602 display [3].

When a radioactive particle passes through the dosimeters tube, microcontroller begins the hardware interrupts function, which increases the counter of the impulses value by 1. Using the "Millis" function, Arduino can count the number of pulses for a selected interval of time. For a quick measurement, MC can take a small time interval of 0.5—1 seconds, but this will decrease the accuracy of measurements. Therefore, the best solution is to take a time interval of 30 seconds, and when the radiation increases to dangerous values, go to a quick measurement of the intensity of radiation.

Intensity of radiation is usually measured in μ R/h or μ Sv/h. As a measured dose usually is used an equivalent dose, that characterizes the biological effect of irradiation of the body with ionizing radiation, measured in Sieverts. Knowing the average value of the radiation intensity for a certain interval of time, it is possible to calculate the radiation dose accumulated by a person during this time.

Sensitivity of SBM-20 Geiger-Muller tube is 420 imp/s for intensity of radiation µR/s. This means that every 105 imp/s registered by the sensor correspond to $1.1 \,\mu$ R/s. Using the obtained ratio, it is possible to recalculate the number of pulses into the value of the intensity of radiation:

$$RAD = N \cdot \frac{60_{min} \cdot 60_{sec}}{P_{av} \cdot dT},$$

where $P_{a\nu}$ — the average sensitivity of the SBM-20 counter to gamma radiation, dT — is the time interval for recording the number of pulses, N is the number of pulses during time interval dT, RAD — is the radioactivity value in µR/h.

The program code of the ionizing radiation meter is shown in Fig. 2—

```
3.
```

```
1 #include <LiquidCrystal.h>
      LiquidCrystal lcd(7, 8, 9, 10, 11, 12);
2 Liquidurystal lcd(r, s, y, 10, 11, 12);

$define bl 4 //mode selection button

4 $define b2 5 //buzzer control button

5 $define zum 3 //buzzer connection pin

$ $define sens 105 //sensitivity of SBM-20 tube

7 $define dt 5000 //measurement period
9 int imp = 0;
10 int doza = 0;
11 float dozaS = 0;
12 bool f_z = 0; //1 - buzzer on, 0 - off
13 bool f_1 = 1; //the choice of units is 1 - R, 0 - Sv.
14 unsigned long t_millis = 0;
```

Fig. 2 — Connecting libraries and initializing constants and variables

```
Fig. 2 — Connecting libr
16D void setup() {
17 pinkode(b1, INPOT_PULLUP);
18 pinkode(b2, INPOT_PULLUP);
20 pinkode(zum, OUTPUT);
21 led.begin(16, 2);
22 led.peint("DoINMER HELLO");
23 delay(2000)]
24 lcd.clear();
25 tone(zum, 100, 50);
26 delay(500);
27 attachInterrupt(0, impuls. F
 26
27
28 }
                  attachInterrupt(0, impuls, FALLING); //pulse trailing edge interruption
29
30 void loop() {
31 if (!digitalRead(b1)) (f_1 = !f_1; led.clear();) //Changing display units
32 if (!digitalRead(b2)) f_x = !f_x; //busser on/off
330 if (millis() - t_millis >= dt) {
4 t_millis = millis();
35 // doza = (imp*3600/sens)/(dt/1000);
36 doza = (imp*3600/sens)/(dt/1000);
37 lod.setCursor(5,0);
                  lcd.setCursor(5,0);
lcd.print(imp);
lcd.setCursor(1,1);
  40 E
41
42
                  if(f_1) (
    lcd.print(doza); //display radiation intencity in uR/s
    lcd.print("uR/s");
                  lca.y-..
}
else {
    doza5 = ((imp/sens)/(dt/1000))/100;
lcd.print(doza8);
    lcd.print("uSv/s"); //display radiation intencity in uSv/s
  44 =
45
46
47
```

```
47 lcd.print("uSv/s"); //display radiation intencity in uSv/s
48 }
49 lcd.setCursor(0,0);
50 if(doza <= 20) {lcd.print("N");} //Radiation intenciti is normal
51B else (
52 if(doza <= 65) {lcd.print("?");} //Radiation intenciti is not than normal
538 else {
54 lcd.print("0"); //Dangerous intencity of radiation
55 }
56 1
57 imp = 0; //zeroing of counted pulses
58 }
59 }
60
618void impuls() {
62 if (f z) {tone(zum, 500, 2);} //when a particle passes, the buzzer sounds
63 imp++;
64 }
```

Fig. 3 — Setup, loop and Geiger-Muller tube pulses counter functions **Conclusion**

The device for measuring ionizing radiation on the Arduino Nano platform and SBM-20 Geiger-Muller counter is proposed. A method for converting the values of the number of pulses into the intensity of radioactive radiation, as well as the calculation of the received radiation dose, is described. The program code for dosimeter is written in the Arduino language.

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CURRENT STEERING DIGITAL-TO-ANALOG CONVERTER WITH EXCELLENT LINEARITY AND REDUCED CURRENT CONSUMPTION ON CMOS 180 nm

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Аннотация. В статье представлены результаты разработки дифференциального 12-битного цифро-аналогового преобразователя, выполненного на принципе суммирования токов. Разработка производилась в САПР CadenceICDesign на основе отечественной 180 нм КМОП-технологии. Напряжение на выходе преобразователя может изменяться от –886 мВ до +886 мВ, при этом быстродействие составляет до 30 MS/s. Отличительными особенностями разработанного ЦАП являются повышенная интегральная нелинейность не более 10 % и пониженный ток потребления не более 80 мкА.

Ключевые слова: ЦАП, КМОП, цифро-аналоговое преобразователь, ЦАП с суммированием токов.

Annotation. In article results of design of current steering fullydifferential 12-bit digital-to-analog converter are presented. This digital to analog converter is based on 180 nm CMOS technology in Cadence IC Design. The DAC output voltage range is from –886 mV to +886 mV and the estimated maximum speed is up to 30 MS/s. The key features of designed DCA are enhanced integral nonlinearity doesn't exceed 10 % and reduced current consumption is not greater than 80 uA.

Keywords: DAC, CMOS, digital-to-analog converter, current steering DAC.

Introduction. Digital-to-analog converter (DAC) is a device that converts a digital code into a proportional analog signal. The following types of digital-to-analog converters are most often used: DACs on binary weighted resistors, R-2R converters, DACs on switched capacitors, sigma-delta DACs, converters with current summation. A DAC circuit with current summation was chosen for our purposes, it has the highest speed from listed earlier and it doesn't contain a large number of resistors and capacitors. Most of analog-to-digital converters (ADC) have digital-to-analog converter in structure. The presented current DAC is being developed for a 12-bit successive approximation ADC. The main requirements for this digital-to-analog converter were the bit error value and conversion speed. The DAC must have a conversion speed at least 12 MS/s, and also provide a conversion error value at this speed less than 0.5 LSB.

Main part. The simplified circuit of current steering DAC [1, p. 110] is shown in Fig. 1.



Fig. 1 — Simplified circuit of current steering DAC

Each digit consists of the current source with $N \cdot I$ current value, where N — weight coefficient equal to the weight of the digit. Sum of LSB currents should be equal to MSB source current.

Basic cell of digit for current DAC [2, p. 2] is shown in Fig. 2. It consists of a current-forming transistor and two transistor keys controlled by a digital code. Vbp source voltage is the same for current-forming transistors of each digit, so changing the width of the current-forming transistor will lead to change of the current flowing through it. The width of each next currentforming transistor is 2 times larger than the previous one, so the currents flowing through it have a value corresponding to the weight of each digit.



Fig. 2 — Basic cell of current summing DAC

The circuit shown earlier has several disadvantages. If the number of digits is more than 7, the current of the LSB digit will be very small compared to the current of the MSB digit, as well as the size of the current-forming transistors of the LSB bit will be large, which will lead to an increase of the chip area. Also, due to the fact that the current-forming transistor is not decoupled from the transistor keys in any way, switching of the transistor keys will lead to a short-term shutdown of the current flowing through the current-forming transistor, which will undesirably influence on the operation of the circuit. To eliminate the shortcomings, the circuit shown in Fig. 3—5 was developed.



Fig. 3 — The circuit of reference current source

The developed DAC consists from two identical differential 6-bit DACs with weight coefficients 64, 128, 256, 512, 1024, 2048, which corresponds to the MSB values. To get the LSB values, the signal from the output of the lower DAC is fed to a voltage divider with a division factor of 64. The bias voltages of current-forming transistors Vbp1 and Vbp2 are forming by a reference current source.

The reference current source consists of cascode current mirrors. This circuit is mirroring the reference current of 50 uA from the reference current source of the chip to DAC. Without decoupling the DAC reference current circuit from the current source of the general circuit, the switching of transistor switches in the DAC circuit will affect the value of the reference current of the entire chip.

Transistors with Vbp2 bias voltage are necessary for decoupling the current source on transistors with Vbp1 bias voltage from transistor switches. Circuits act as a power source for current sources, in fact, they stabilize the voltage on the drain of current-carrying transistors, stabilization eliminates the influence of voltage surges caused by switching of transistor switches.



Fig. 4 — The circuit of MSB and LSB DAC



The designed DAC has enable pin (EN). When a logical high voltage is supplied to this pin, the DAC is disconnecting from the power supply circuit, providing the lowest current consumption in idle mode.

The output characteristic of developed DAC is shown in Fig. 6a. The linearity of the output characteristic of DAC can be obtained by differentiating it's the output characteristic. The linearity of the output characteristic of developed digital to analog converter is shown in Fig. 6b. Spikes in linearity characteristics appear due to switching from MSB DAC to LSB, but their value is within the normal range. Differential nonlinearity of DAC is less than 0.1 LSB.



Fig. 6 — The DAC output characteristic (a) and its linearity (b)

The designed DAC performance is summarized in Table 1.

Table 1 — Summary of the designed DAC performance					
Specification	This paper	[2, p. 5]	[3, p. 6]		
Technology	CMOS 180 nm	CMOS 180	CMOS 250		
Technology	CIVIOS 160 IIII	nm	nm		
Anabitaatuma	Cumont staaning	Current	Segmented		
Arcintecture	Current steering	steering	R-I hybrid		
Supply voltage, V	3—3.6	3.3	1.35		
Temperature range, °C	-6085	N/A	N/A		
Output trips	Duffored Voltage	Buffered	Buffered		
Output type	bulleled voltage	Voltage	Voltage		
Resolution, bit	12	12	10		
DNL/INL (LSB)	0.10/0.10	0.42/0.42	6.38/7.55		
Maximum sample rate,	20	0.5	20		
MS/s	50		20		
Current consumption,	80 uA (if EN is low)	190 uA	1.30 mA		

Table 1 — Summary of the designed DAC performance

not greater than	400 nA (if EN is	
	high)	

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REASONS FOR SLOWING DOWN THE GROWTH RATE OF COMPUTING POWER OF PROCESSORS BY USING DIFFERENT MATERIALS

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Аннотация. В статье рассматривается актуальная проблема снижения темпов роста вычислительной мощности процессоров на основе кремния.

Ключевые слова: закон Мура, процессор, плотность, транзистор, кремний.

Annotation. The article deals with the actual problem of reducing the growth rate of computing power of silicon-based processors. Possibilities of substitution silicon by other materials in microelectronic integrated circuits and processors to provide the enough computing speed is discussed in the paper.

Keywords: Moore's law, processor, density, transistor, silicon.

At the moment, microprocessor technology is one of the fundamental areas of development of all electronics. Communication systems, computer systems, automation systems and many others work on its basis. It is difficult to imagine the modern world without microprocessors, and at the moment the development of this direction is proceeding at a tremendous pace. The first microprocessor that became widespread was created in 1970 by Edward Hoff, it was similar to a mainframe processor, and in 1971 the intel-4004 microprocessor became available on the market. This microprocessor is disproportionately cheaper and more efficient than the ENIAC computer. It included 2300 transistors, it worked at a frequency of 750 kHz, and the command system consisted of 46 instructions. Since then, 13 generations of intel processors have changed, and the number of transistors on a chip has grown hundreds of thousands of times. At the moment, the density of transistors is about 250 million per sq.mm., which corresponds to the 7-nm process technology, however, TSMC has scheduled the release of chips created according to the 3-nm process technology, the production of which should begin in the second half of 2022. The number of transistors in the 3nm process corresponds to 290 million transistors per square mm [3, p. 1]. Along with the density of transistors, the frequency of processors also grew, which created an exponential increase in processor performance. In 1965 (6 years after the invention of the integrated circuit), Gordon Moore noticed that the number of transistors on a chip was doubling every two years. Later this observation was called Moore's law. Moore's Law was successfully observed until 2000, however, a problem arose. When mastering the 100-nm process technology, engineers encountered quantum tunneling, which became a serious limitation on the way of sealing transistors, difficulties also arose due to the internal electrical resistance of transistors. Let's look at these problems in more detail[2, p. 159].

Tunnel current. The electron exists according to the laws of quantum mechanics and exhibits wave-particle dualism. It follows from the Heisenberg uncertainty relation that the parameters of the spatial position of the electron cannot be determined more precisely by the Planck constant. If we imagine a structure consisting of an n-type metal-dielectric - semiconductor, electrons from the metal layer cannot penetrate into the dielectric, since the region of forbidden energies will not allow them to exist inside the dielectric, but an electron has a chance to penetrate into an n-type semiconductor bypassing the dielectric layer. The chance of this penetration is the higher, the smaller the dielectric layer. This mechanism also works for n-p-n layers of silicon. The p-region is the region of forbidden energies for electrons from the n-region, however, if the p-region is less than 8 nm, the electrons freely tunnel from the source to the drain, which limits the minimum base width to 8 nm.

The resistance of the transistor elements. This problem stems from the basics of electrical engineering. The higher the resistance, the longer the conductor and the smaller its cross-sectional area. Thus, we get that reducing the size of the transistor by 2 times will increase the resistance by 2 times. High resistance causes a voltage drop, which can be critical for transistors where the voltage can be 1V or lower.

Summing up, you can see that reducing transistors to infinity will not work. The main problem is the breakdown of the transistor base. To overcome this problem, it is necessary to reduce the area of spatial charge. This can be done either by increasing the content of impurities in silicon, or by reducing the external voltage.

But new problems arise - it will not work to reduce the voltage further. At the moment, it is 1V, which is the minimum threshold for the normal operation of transistors, the reason for this is the resistance. By increasing the concentration of impurities, we will increase the tunnel current, as well as the risk of avalanche breakdown of the junction and base [1, p. 78].

All of the above, as well as factors not taken into account here, do not allow making the base less than 25 nm wide, which means that further productivity growth due to an increase in the density of transistors will soon become physically impossible. Another way to increase the processing power of the processor is to increase the clock frequency. The clock frequencies of processors grew almost as rapidly as the number of transistors, however, due to the transition to 100 nm, the distance between transistors became so small that current leakage became almost equal to the consumption currents of transistors, as a result of which the number of errors in calculations increased, as well as heat generation and power consumption. A further increase in clock speeds will lead to the need to use complex and expensive cooling and power systems, and the increase in computing power will not be so significant.

Any newly discovered technology first experiences extremely rapid growth, and after overcoming a certain point, the pace of development slows down, and slow development begins. At the turn of the 2000s, engineers faced physical limitations in increasing the computing power of processors, which led to the development of more complex technologies, such as multicore, multithreading, as well as the use of narrow-profile coprocessors. But even so, the pace of progress is decreasing, and, probably, in the future it will be necessary to look for radically new approaches to meet the constantly growing demand that requires ever greater computing power. The way out of this situation may be the use of analogs of silicon (graphene, molybdenum disulfide) in the production of processors, or the transition to quantum computing allowing disproportionately faster to solve complex problems.

Of course, this doesn't mean that silicon supply on the Earth are on the wane. There is enough silicon inside our iron-stony planet for glass making,

for building materials and other products of large tonnage chemistry. The silicon substitution by other products is actively searched in only one sphere which is well known. It is silicon microelectronic integrated circuits and processors because sooner or later they will not be able to provide the enough computing speed.

One of more probable means of calculating technics effectiveness improvement is the transition to other different principles of calculations. Such researches are conducted in many developed countries: quantum, molecular, bionic computers etc. are developed. Nevertheless, a lot of specialists engaged in computing technics and semi- conductor materials suppose that one can make Moore's law live longer using usual semiconductor circuits but replacing their main element – silicon- with something else. Substitution (at least while producing some parts) crystal silicon for a material the thickness of which is in maximum several dozens of atoms could permit to lessen the circuits sizes by ten folds.

Nowadays silicon is tried to substitute yet by other materials. Modern silicon plates have some quantity of gallium arsenide, dioxide hafnium, germanium alloys. All these inclusions and alloying additions are applied to change the silicon properties. Examples of operating transistors made of one atom molybdenum disulfide and black phosphorus layers are known. It is assumed that different combinations of materials can increase the calculating speed in a thousand times as well as decrease considerable a computer power consumption [4, p. 563]. The main question is that the existing technology of microcircuits production could operate with such materials. Five or seven yeas ago producers of microcircuits told about electronic devices made from exotic materials: "Yes, it is interesting, but how do such devices go together with silicon circuits?" And now when the Moore's law is in question many of them turn around searching practical solution.

For some time, the graphene was considered as the lifesaver of the Moore's law. But it isn't a semiconductor. The width of the graphene forbidden energy band is equal to zero. It means that it is practically the ideal conductor and it cannot be a material (as other metals) for transistors fabrication. They can not be regulated while changing into different states. Sure, there are some methods of making semiconductors from graphene. For example: the graphene band the width of which is 10 nm can act as semiconductors. Or one can reinstate the graphene by hydrogen receiving the extended two-dimensional hydrocarbon graphene (combination graphene-graphane). Such combination can operate as semiconductor.

Even though the graphene didn't deliver on expectations as material for semiconductors, its mission it performed. Having learned working with graphene researchers search now the silicon alternator semiconductors between other micro-thin quasi-two-dimensional materials.

One of thefuture-oriented substances as the analogue of silicon is the molybdenum disulfide. Unlike the graphene which is also considered for using in this sphere, the molybdenum disulfide doesn't require the complex synthesis. Its application is determined by its wide popularity, the proper crystal lattice, relative simplicity of technological process. Efforts to develop operative patterns of microelectronics from molybdenum disulfide have educed the main difficulty of such material production usage, i.e., high resistance between molybdenum disulfide and metal contacts that showed the large dispersion of parameters between some test samples. That's why researches were aimed at the variation of phase condition of a molecule itself. Results have shown that the molybdenum disulfide can be of two different states. In one of them it reveals the properties of semi-conductor and in other one it exhibits features of metals. One can regulate the molybdenum disulfide molecule state by means of the organo-lithium compound synthesisto It makes possible to change the molecules states in the contact area enabling create stable components with high repeatability. So, if the test results show the stability of the molecule state at typical electronics operating temperature, the introduction of corresponding technologies into the word market will be only a matter of time and investments in this sphere of investigations.

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AUTOMATION IN OIL AND GAS PRODUCTION AND TREATMENT

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Аннотация. Добыча нефти и газа в настоящее время является одной из ведущих отраслей промышленности, влияющей на внешнюю и внутреннюю экономику государства. С каждым днем исследуются все больше месторождений, создаются новые способы переработки сырья, свойства изучаются И характеристики новых материалов И компонентов, которые обеспечат больший выход продукции и увеличат срок работы аппаратуры. В связи с жесткими требованиями к производственной безопасности и необходимостью соблюдения экологических норм, у заводов появляется потребность в автоматизации во избежание потерь и улучшения контроля производства. Так, использование новых технологий и нейронных сетей выведет производство на новый уровень и сравнительно возвысит среди конкурентов.

Ключевые слова: добыча нефти и газа, переработка нефти и газа, автоматизация, нейронные сети, информационные технологии, улучшение качества

Annotation. Oil and gas production is currently one of the leading industries affecting the external and internal economy of the state. Every day more and more fields are explored, new ways of processing raw materials are created, properties and characteristics of new materials and components are studied, which will provide a greater yield of products and increase the lifetime of the equipment. Due to the stringent requirements for industrial safety and the need to comply with environmental standards, plants have a need for automation to avoid losses and improve production control. Thus, the use of new technologies and neural networks will bring production to a new level and comparatively elevate it among competitors.

Keywords: oil and gas production, oil and gas treatment, automation, neural networks, information technology, quality improvement

Digitalization has confronted many industries and the oil and gas industry is no exception. The development of artificial intelligence and machine learning technologies makes it possible to significantly speed up processes related to the extraction and processing of extracted raw materials, to secure the production structure, and to improve the economic side of production work. There is a need to switch to renewable sources, which is only possible with full control of production, which, in turn, can be provided by automation.

Processes are digitized in every production. Large-scale process systems are made up of a list of several inputs:

1. Remote management of operations. The use of such control allows, with the help of modern technology to achieve high results without personal presence of the worker on site. It allows exploring previously unexplored

fields, using robots to work in dangerous places for humans, as well as performing monotonous work with harmful substances. Remote control is also used in accounting for worker control and financial calculations.

2. Construction of real production models. Such technologies allow quality immersion into the working atmosphere and learning of technological processes before encountering problems in reality. Such programs provide an opportunity to make a mistake, which will not affect the real process, but will allow to come to the desired result with the right number of attempts. Moreover, the construction of this kind of simulators makes it possible to anticipate possible work for future research. For example, the company "Rosneft" has developed an industrial simulator of hydraulic fracturing [6, p. 50].

3. Control of production errors. The introduction of special programs that monitor and signal in case of failure or overload allows a person to stop the process in time, avoiding a deplorable result. Moreover, most programs are configured to automatically shut down the machine, the main essence of such technology is to monitor and mitigate the consequences. Often, it is used when dealing with possible emissions, such as methane [6, p. 51]. For this purpose, stationary sensors are used to provide monitoring and automatic initiation of repair work.

4. Diagnostics and repair works. The control of technical components of the equipment allows to extend the possible service life and to write off the non-working equipment in time to prevent possible malfunctions of the system. The main task is to remove the equipment that is not working in time, otherwise it will lead to an accident in the future.

5. Introduction of simulation to adjust input and output parameters. Programmed device operation that calculates the right amount of material or the right temperature and pressure parameters allows for efficient operations while obtaining the highest yields. In many apparatuses it is necessary to control constant parameters and properties, it is important to add the right number of components. Otherwise, the device will not work correctly or will lead to accidents.

6. Digitalization of the search for deposits. This kind of automation makes it possible to identify previously unexplored fields technologically, without the need for physical contact with the terrain. Such technologies make it possible to calculate the size of the drill well, which significantly saves energy and chemical resources. Unfortunately, at the moment, such a program is not fully operational in Russia due to the low level of well exploration. Lack of geographical data does not allow to fully ensure the correct operation of the equipment, which can lead to incorrect perforation and errors in the system [3, p. 217].

7. Electronic systems and databases. No production can do without documentation. Every company sooner or later faces the need to store and search for the information they need. So, database automation allows workers to refer to the standards they need, as well as to maintain documentation with descriptions of operating characteristics from anywhere in the world.

Process automation involves working with mathematical and physical models that are built on the principle of reducing human involvement to facilitate production. The work of automation is directly related to the creation of artificial intelligence, which, in turn, does work similar to neurons and neural connections [2, p. 115]. The neuron receives information, processes it, and passes it on for classification and regression. The task of classification is to determine whether a component belongs to one of the classes, relative to the given parameters of the system. The regression task is to make a prediction of further actions or to analyze and fill in missing parts in the chain of information transfer. A set of neurons is a complex structure of non-linear dependencies with its input and output parameters. Once you understand the principle of artificial intelligence, you can use it to automate a lot of processes not only in the oil and gas industry. Not only does it simplify the work that a human could do, but it also greatly speeds up the process and minimizes output errors. By creating a clear data transfer structure, the software installations can be made to work smoothly, allowing you to focus on other, more important parts of the job where the human factor is needed.

The simplest example of neural networks is a multilayer perseptron, which performs several processing steps to find the output parameters [1, p. 2]. The essence of it consists in the calculation of the error, one algorithm which trains all the other layers. Due to this, the system will consider the possible error of the results and output the data closest to one of the variants, set in advance. The only criterion for such a system is the standardization of data - reduction to a single dimensionality to allow comparison, calculations and output of results in a certain range of values. In order to obtain accurate results, there is a need to evaluate the results obtained, namely, to assess the adequacy of the system. Since the initial model is built on a training sample, it is necessary to analyze a test sample of data to determine the performance with real data. So, the automatic control system with deviation allows you to maintain the regulated value in the required range of values. There are two types of regulators: continuous and discontinuous (discrete). Continuous regulators provide continuous operation and provide an analog output in the value range of 0 to 100. Discrete regulators, on the other hand, are most often the basis of automatic regulators and their output parameters occupy certain position values. Such regulators are used to control temperature, pressure, flow, etc. The dependence between input and output signals plays the main role. The most popular are PID regulators (proportional-integral-differential regulators). Such a controller can affect the object almost according to any law. When a step change in a value occurs, the controller affects the object by causing the value to decrease significantly, after which the integral component increases the value of the value by causing it to approach the desired level as closely as possible. An example of such a controller is shown schematically in Figure [2, p. 42].



The artificial neural network has a complex multilayer structure of parallel connections. Due to this, calculations are performed not sequentially, but in parallel, which provides high speed and the ability to process several types of data at once. Such neural systems allow efficient data processing in oil and gas production process modeling. Building mathematical models provides the ability to predict the output data to determine the parameters of the apparatus. For example, in separator operation it is necessary to find and regulate input and output parameters of the system and PVT-properties. The use of the equation of state will make it possible to calculate the best possible properties of the system, considering the enthalpy. Thus, with the help of mathematical modeling it becomes possible to regulate pressure and temperature at the apparatus outlet to ensure iso-enthalpy process, as well as to calculate phase equilibrium. And the installation of intelligent sensors allows temperature and pressure criteria to be reported without the need for an on-site presence. This parameter monitoring and calculation system allows for the most efficient operation of the equipment and increases production efficiency. Neural networks make it possible to obtain measurement results that previously could only be obtained by laboratory analysis. Such technology is used to predict variables that determine product quality, such as the amount of a certain impurity in a commercial product, emissions into the air, and other indicators [5, p. 100]. Neural networks are used in industrial applications to replace physical sensors and in laboratories to perform physical and chemical analysis in oil and gas refining and development of necessary additives. Training of neural networks is possible with the use of archived databases, the implementation of which has been made earlier. Automation in production in oil and gas production and preparation exists in the role of an additional living organism, which at this stage is at the initial stage of development.

For the most part, automation is most beneficial in those processes that are energy-intensive. For example, drilling is a dangerous and complex process that is extremely difficult to ensure complete safety. Digitalization of such a process, namely, ensuring the automatic operation of manual processes will save work time as well as ensure the safety of workers. The most popular is the monitoring of drilling wells with the help of a digital twin. A mathematical model is created that includes mechanical characteristics and helps calculate many parameters: SPP, ECD, temperature, cuttings concentration, etc. These models compare downhole conditions with ideal conditions to track changes during drilling. This principle of operation allows to detect well wear and tear in advance and diagnose possible damage [7, p. 9].

In addition to drilling, automation finds its application in other types of gas production - hydraulic fracturing. This is a complex and energy-intensive process in which large amounts of resources are consumed, so there is a need to optimally regulate pressure delivery parameters. Mathematical models are being written and numerical methods for fracture nucleation and propagation are being developed. Three-dimensional models allow us to determine the necessary critical pressure that will cause rock failure, as well as calculate the shape of the fracture. Gas production from tight shale rock becomes possible only with the use of hydraulic fracturing, making this technology necessary for the industry. At the same time, it is the most dangerous for the environment. It destroys geological structures and causes pollution of groundwater. It requires large quantities of water to operate and, afterwards, some of the fluid, contaminated with trace elements, is released to the surface, contaminating the soil and the air. Therefore, it is necessary to calculate the exact amount of pressure and substances to be injected in order to have the least impact on shale structures and the atmosphere. Moreover, due to the big risks to the environment, it is important to monitor the deposits so as not to unnecessarily affect the geological rocks.

The next important aspect is the monitoring of pipelines and weather conditions. This monitoring is most relevant in the offshore industry, where there is no access to the pipeline directly [8, p. 638]. Automation of such a process makes it possible to visualize inaccessible locations and provide continuous monitoring of equipment with possible quick repairs as needed. Weather surveys, on the other hand, provide an opportunity to select the most suitable conditions for operations, since many oil and gas companies operate in extreme conditions where weather conditions are often unpredictable.

The biggest obstacle to the oil and gas industry is the environmental problem. Air pollution, oil spills, methane and greenhouse gas emissions all have a negative impact on the environment. Oil and gas currently account for approximately 42% of global greenhouse gas emissions. Of these, 33% come

from the combustion of these fuels, and 9% come from the oil and gas industry itself, which the industry can control [6, p. 49]. Therefore, automation in this area is the key to solving many problems. It is monitoring and the use of new advanced control technologies that reduce industrial emissions. Due to the fast and efficient operation of software controllers, better maintenance of equipment becomes possible, which avoids premature unplanned emissions and accidents in production [4, p. 416].

At the moment, Russia is facing two ways: to use foreign systems to work with our own fields or to build our own import-substituting modules. Foreign software is already in use, and therefore, implementing it in our environment with parameter redirection is not something difficult, compared to creating our own software. However, due to unavailability, these days, of most of the working software such as Aspen Hysys, Unisim on which our production worked earlier, there is a need to write our own mathematical modules which could provide better performance of the equipment. The trend in recent years shows that "Rosneft" and "Gazprom Neft" are allocating significant amounts of money for the digital transformation of their production facilities, which is reflected in the figures obtained. One of the important recent innovations is the program "Digital LUKOIL 4.0", which is based on the introduction of tools based on digital models to reduce the number of planned and unplanned downtime. Implementation of such a program makes it possible not only to ensure efficient output due to digital monitoring of equipment, but also to ensure remote control of production, facilitating withdrawal of unprofitable and introduction of new automated equipment [6, p. 43].

Thus, the automation of the oil and gas sector can solve many issues related to production and preparation of oil and gas, namely: reduce downtime of oil wells and equipment; minimize the continuous presence of service personnel at facilities; increase oil production; improve operational safety and reduce the number of accidents; reduce oil, gas and water losses by accurate accounting and others. Automation of processes in the oil and gas industry is necessary to reduce the impact on the environment, since at present, this industry pollutes the atmosphere, soil and water bodies more than any other. It is better to anticipate accidents in advance with smoothly running equipment, rather than deal with their irreversible consequences later.

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UDC 52

THE MOST PROFITABLE SOURCE OF ENERGY

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Аннотация. В данной статье представлена информация о лунной станции, которая станет наиболее выгодным источником энергии как на Луне, так и на Земле. Также описаны основные преимущества и недостатки данной станции по сравнению с другими источниками энергии. В статье описывается, как должна выглядеть станция, где она должна располагаться и как она должна работать. Здесь также содержится информация о добыче топлива и преимуществах использования термоядерной реакции. В статье представлена и описана модель и рассчитана экономическая целесообразность.

Ключевые слова: Луна, лунный, станция, гелий-3, реголит, реактор

Annotation. This article provides information about the lunar station that will be the most profitable source of energy both on the moon and on earth. The main advantages and disadvantages in comparison with other energy sources were described in this article. The article describes how the station should look, where it should be located and how it should work. It also provides information on fuel extraction and the benefits of using a thermonuclear reaction. The article presents and describes the model and calculates the economic benefit.

Key words: moon, lunar, station, helium-3, regolith, plant.

Introduction

The Moon is one of the stages of space exploration. Half a century ago colonization of the Moon seemed something impossible, but with the advent of the 21st century, the century of new technologies and engineering discoveries, this dream can become our reality. Due to its proximity to Earth (three days of flight) and a fairly good knowledge of the landscape, the Moon has long been considered as an option for the creation of a human colony.

Relevance

A cost-effective source of energy is required to deploy and support the operation of a base on the moon. Ideally, the station should work from minerals on the Moon, since various emergency situations are possible when delivering fuel from Earth. Therefore, helium-3, which is contained in the lunar regolith, will be an ideal fuel. This project is dedicated to a nuclear power plant on the Moon based on a space thermionic Nuclear Power Plant

as one of the most profitable sources of electricity in terms of construction and financial costs.

The problem of the energy source on the Moon, the analysis of various options for power plants on it

Among other important issues that have to be resolved it is very important to provide the lunar base with energy. The problem with an energy source on the moon is that depending on the location you might be in the dark for 14 days. Therefore, it is extremely unprofitable to use solar panels. In addition, they are impractical, as moon dust can quickly damage them. The presence of water is important for the lunar base, so it should be located near the constantly shaded crater in which it will presumably be possible to extract water ice. Liquid water cannot be on the lunar surface as it evaporates under the influence of sunlight and then dissipates into outer space. If solar panels are used as an energy source, it will be necessary to lay long cables from solar panels to the base.

But nuclear power can solve the problem of a source of continuous energy in the sun or in the shade. The electricity demand of the base of the first stage with a crew of 3 or more people with the appropriate infrastructure including lunar rovers with robotic manipulators is estimated at 100 kW according to the design studies of PAO S. P. Korolev Rocket and Space Corporation «Energia».

The option with a nuclear power plant promises a lot of advantages compared to solar panels. A miniature nuclear power plant would supply current continuously and take up space like a bus. American engineers are considering two options for placing a mini-nuclear power plant on the Moon: 1) On the surface; 2) In a container buried in the ground. The first one is easier to build, but to ensure a normal radiation situation, it will be necessary to remove the power plant from the edge of the base by one kilometer, and the weight of protection will be higher. The second one will require "earthworks", but the safe distance from the NPP to the border of the base will be only 100 meters, and the station itself will be lighter [2].

This system will be based on a small nuclear reactor (the size of an ordinary trash can) cooled by liquid metal (a mixture of sodium and potassium). In this case, it is advantageous to use Stirling engines. In a series of tests, Stirling generators produced a continuous power of 2.3 kilowatts, and the efficiency was 32%. Also, future system should contain radiators designed to dissipate heat from stirlings in space. The material of such panels should work well under extreme temperature differences between lunar day and night, as well as in vacuum. The radiator design should be as light as possible. According to the research conducted at the Glenn Center, the radiator effectively removes up to 6 kilowatts of heat in "Moon conditions",

which is even more than the creators of the device expected. The lunar power plant will require 20 such panels.

After their deployment, the wingspan of the station would be 34 meters. At the same time, the installation itself would occupy 7 meters in height 2 of which would fall on the underground part (See Fig.1).



Figure 1 – Model of a miniature nuclear power plant

Advantages of helium-3 as a fuel for a nuclear power plant

Helium-3 has been gradually accumulating in the lunar regolith for billions of years by solar wind irradiation. The solar wind is a stream of ionized particles (mainly helium-hydrogen plasma). It does not get to Earth, "beaten" away by the magnetic field of our planet. But it gets to the moon, that doesn't have a magnetic field. As a result, a ton of lunar soil (in the thinnest near-surface layer) contains about 0.01 grams of helium-3.

The $3\text{He} + D \rightarrow 4\text{He} + p$ reaction has a number of advantages over the deuterium-tritium reaction $T + D \rightarrow 4\text{He} + n$, which is most achievable in terrestrial conditions [1].

1)- If we consider atomic energy, we understand that its main problem is radioactivity. Not only the radioactivity that is generated by the nuclear reaction itself, but also the radioactivity that is present in the construction materials. The neutron flux is generated in most working nuclear reactions. Neutrons are neutral particles. They penetrate deeply into materials, cause their radioactive contamination and defects in their structure. Such materials and parts of structures need to be changed in a few years, and then buried somewhere. This also applies to the well-known thermonuclear reaction of deuterium with tritium. But in the reaction of helium-3 with deuterium, a stream of protons is born but not neutrons. Since protons are charged particles, they do not pass inside the material, therefore they do not lead to defects in the material. The material, which in the usual case can last 2-3 years, in the case of using helium-3, can be used for 30 years. The flow of protons is very convenient from an engineering point of view: the flow of charged particles is practically an electric current. It is easy to convert it into electricity.

2)- The reserves of helium-3 on the Moon are huge (about one million tons). These reserves can be used for more than thousand years.

3)- The energy efficiency of helium-3 is also huge: 1 ton of helium-3 replaces 20 million tons of oil.

4)- When we talk about the development of the Moon and its resources, we must understand that there is not a single mineral or substance that would be economically profitable to bring from the Moon to Earth, with one exception. This exception is helium-3. The cost of its delivery to Earth will be ten times less than the cost of the electricity currently generated at nuclear power plants. And the efficiency is greater.

In addition, this reaction has disadvantages, one of which is a significantly higher temperature threshold. It is necessary to reach a temperature of millions of degrees. The reaction between helium and deuterium does not occur at temperatures below.

The way the station is delivered to the moon

A nuclear power plant weighing about 7 tons with an electric capacity of up to 150 kW is delivered to the surface in a fully assembled form and installed near the inhabited base at a distance of about 1 km. Site preparation, transportation and installation of nuclear power plants can be carried out by the following robotic devices. A cylindrical recess with a diameter of up to 1 m and a depth of up to 2 m should be made in the surface before installing the station (See Fig.2). The nuclear power plant with the help of an assembly robotic device with a load capacity of up to 10 tons is installed by the head reactor unit in the recess. After that, a circular protective shaft of trapezoidal cross-section with an average thickness of 3-4 m with a total soil mass of at least 200 tons is made from the soil using an earthmoving device. To protect the elements of the nuclear power plant from gases and water vapors desorbed during heating of the soil, a metal shell must be installed inside the recess and the protective shaft using an automatic welding unit. A specialized device connects the converter complex located behind the protective shaft to the nuclear power plant and installs control and power cables from the nuclear power plant to the base. Cables may need to be laid in a trench to protect them from micrometeorites. Capacity increase is possible by additional installation

of both similar nuclear power plants and more powerful ones built using the same technology.



5 - refrigerator-radiator based on heat pipes;

6 - shaft of radiation protection from lunar soil.

Figure 2 – Station placement

It would be reasonable to send a robot to build residential modules, nuclear power plants and the entire Lunar base. And send the cargo to the moon in successive parts. When transporting cargo, the most profitable solution will be reusable launch vehicles, that will have significantly higher efficiency than launch vehicles at the moment (which is about 3.2%). We need to look for opportunities to obtain nuclear fuel or its components using technology on the moon itself. For the first stage, until the process of extraction and synthesis of useful resources into fuel for nuclear power plants begins and enters into circulation, it is required to deliver fuel for the initial operation of the nuclear power plant to the Moon. We need special sealed containers or capsules capable of withstanding enormous overloads in order to deliver fuel for the first time.

Economic feasibility

In conclusion, we should notice that the energy capacity of helium-3 is huge. One ton of this substance ensures the operation of units with a capacity of 10 Gigawatts during the year. One ton of helium-3 replaces 20 million tons of oil. At the current cost of oil (about \$ 50 per barrel), the cost of 20 million tons of oil is \$ 10 billion. This is the current price of 1 ton of helium-3. Transportation of one kilogram of cargo on the trajectory of Earth-Luna-Earth is approximately 20-40 thousand dollars. To transport 1 ton of helium-3, you will have to transport 2-5 tons of accompanying cargo in the form of containers, cooling equipment, etc. Thus, the transportation of one ton of helium-3 from the Moon will cost \$ 100 million. It seems like a huge amount. But this is only 1% of the cost of the energy that one ton of helium-3 can provide on Earth.

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INTELLIGENT CONTROL AND MONITORING SYSTEM FOR ELECTROMAGNETIC MASS ACCELERATOR GAUSS Timur Vereshagin

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Аннотация.Данная статья описывает принцип управления и построения электромагнитного ускорителя масс Гаусса. Был проведён сравнительный анализ существующих аналогов на основе тиристоров. Определено, что существующие методы обладают недостаточной эффективностью по причине строгого расчета под определенные геометрические характеристики разгоняемого тела и физические характеристики элементов системы, что ведёт к несинхронности работы элементов системы по причине не идеальности компонентов и их деградации со временем. Был разработан метод управления системой на основе построения цифровой копии устройства с использованием датчиков слежения за положением тела и контроля состояния элементов системы, а также протекающих в ней процессов.
Ключевые слова: ускоритель массы Гаусса, электромагнитный ускоритель массы, сравнительный анализ тиристоров, метод управления системой, датчики слежения и контроля

Annotation. This paper discribes the principle of opperation and construction elecromagnetic mass accelerator Gauss. Exestant analogues on the basis of thyristors was comperatively analyzed. It is determined that existing methods have the lack of effencity caused by inflexible calculating for a specific geometrical characteristics of accelerated object and physical characteristics of system elements, that leds to non-synchronization work of the system elements that caused by components imperfection and their retrogression in time. Method of system managing on basis of construction digital copy of device with using object position and speed tracking sensors and processes condition and system elements condition control was developed. Keywords: voice control, partial automation, electromechanical modules, experimental device, energy saving

Keywords:Gauss mass accelerator, electromagnetic mass accelerator, comparative analysis of thyristors, system control method, tracking and control sensors

Introduction

In the modern world, many projects require the acceleration of capsules to high speeds in which the mechanical actuators that accelerate the cargo must be dispensed with. Electromagnetic mass accelerators are suitable for such requirements, such as electromagnetic mass accelerator Gauss. But such systems have disadvantages, such as:

- Low efficiency
- High component requirement
- High peak currents
- Low capacity per unit mass of portable power supplies

A smart control system based on one of the IoT paradigms, which states on necessity of building a digital copy of the device in use [2], can help reduce the impact of most of these problems and even negate some. The implementation of such a system will make it possible to monitor the status of many components of the system, which will not only prevent sudden failure of the device, but also increase the efficiency of the system by more precise dosing of energy supplied to the electromagnets that accelerate the accelerated object.

PRINCIPLE OF THE GAUSS MASS ACCELERATOR

Gauss electromagnetic mass acceleration named after german scientist Carl Gauss, who laid the foundation for the mathematical theory of electromagnetism. Gauss's electromagnetic mass acceleration consists of one or more solenoid coils that create a "running" magnetic field in which an object made of ferromagnetic material moves, similar in principle to a linear motor, as well as a control system that coordinates the inductors so that the accelerated object is not inhibited when it leaves the inductor. In this case, the ends of the accelerating object form poles oriented according to the poles of the coil, due to which after passing the center of the solenoid the object is attracted in the opposite direction, it brakes, which should be avoided by the control system to increase the efficiency of the system. As shown in Figure 1.



Figure 1 - Installation of a Gauss electromagnetic mass accelerator

Review of similar solution

In modern times, a pre-calculated thyristor inductor control system is most commonly used [6]. The source of its benefits and the potential drawbacks is the thyristor, which has a low channel resistance, but does not have the ability to close it at any time, which imposes restrictions on the flexibility of the system control.

Benefits of the thyristor system:

- Simplicity of design
- Relative cheapness

Drawbacks of thyristor system:

- Low efficiency
- Difficulty of calculations
- Less control flexibility.

System description

To eliminate the disadvantages of the thyristor control circuit, it is proposed to use n-type MOSFET transistors that allow not only open but also close the current passage to the inductor, which, when using a more complex control system, opens up more flexibility in controlling the circuit and gives an opportunity:

- Disconnect power to the inductor when the capacitor is overcharged

- Use capacitors of higher capacity to maintain the declared kinetic energy of the object even if the power supply is degraded.

- Programmatically reduce the kinetic energy of the object by prematurely disconnecting the power supply to the inductor.

At the same time to control this type of keys is more difficult because of the presence of the gate capacity which must be charged to open the transistor and respectively discharged to close the key [1]. In this case the opening and closing times (1) should be much less than the inductor running times which depend on the geometric dimensions and the necessary speed increment (2). To solve this problem, the industry produces many MOSFET transistor drivers, this solution not only permit to quickly open even transistors with large gate capacitance, but also permit to monitor the current flowing through the transistor, protecting it from overcurrent.

$$t = 3 * \frac{U}{I} * C_G \tag{1}$$
$$t = \frac{2L}{\Delta v} \tag{2}$$

One of the main indicators of the control system will be the theoretically possible time of attraction of the object at flying out of the solenoid coil. Without taking into account the degradation of electrolytic capacitors with time, their high allowable deviation in capacity equal to an average of - 20% for new capacitors must not be neglected [4]. Using for calculations Thomson formula (3), the inductor operating time can be calculated. It will be by 9% more than necessary time, during which the object will be braked by the inductor, which in turn will lead to a decrease in the efficiency of the entire system, while simulation in the program Femm 4.2 with third-party add-on femm-coilgun[3]showed a drop in efficiency of 25%, while the energy of the accelerated object decreased by 10%.

$$T = rac{\pi \sqrt{LC}}{2}$$

(3)

This can be avoided by monitoring the position of the accelerating object in the accelerator's barrel. Problem can be solved by using of infrared obstacle sensors, permanent infrared LEDs and infrared phototransistors, shining through holes in the barrelshown in Figure 2 [5].



Figure 2 – Acceleration of the body in the barrel of the accelerator

- 1 The reproachable body
- 2 IR LED
- 3 IR phototransistor

All sensors are connected to the interrupt ports of the microcontroller, which reduces the delay to a minimum. Also knowing the transit time of each coil, we can calculate the speed (4) developed by the accelerated objects,

which will make it possible to track abnormal changes in the operation of the system.

$$u_n = u_{n-1} + \frac{2L}{\Delta t} \tag{4}$$

In order to control the wear of the tube guide, a sensor is added at a certain distance from the inductors shown in Figure 3, that made it possible to calculate the sliding friction force of the accelerating object in the acceleration unit (5). The data collected not only help to calculate the operation of the circuit, but also in case of severe wear can inform the user about the malfunction of a particular component.



Figure 3 – General scheme

1,2,3 - solenoid coils 4,5,6,7,8 - Obstacle sensors $F = \frac{\Delta v_{8-7}}{\Delta v_{8-7}}$

(5)

Electrolytic capacitors are suggested as energy storage devices. They have a significant disadvantage, the capacitance decreases over time and the growth of internal resistance, leading to heating and even depressurization of the capacitor. To control this parameter it is proposed to charge the capacitor with a low voltage to measure the capacity by calculating it according to the formula(6)[7].

 $v(t) = IR(1 - e^{-t/\tau})$

(6)

To control the elements of the system is proposed to use a microcontroller company "STMicroelectronics" series STM32F407. This series of microcontrollers has sufficient performance to control all systems in real time, as well as a sufficient number of GPIO (general-purpose input/output - general-purpose input/output interface) allowing you to configure them as to interrupts and to ADC (analog-to-digital converter)



Figure 4 – Block diagram of the system

Conclusion

In the course of the work, an intelligent control system for the Gauss mass accelerator was powered and simulated. Simulations showed a 25% drop in efficiency with the new capacitors while reducing power by 10%.

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MODULATION AND TRANSMISSION OF CSS (CHIRP SPREAD SPECTRUM) MODULATED SIGNAL USING PYTHON AND SDR

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Аннотация. Эта статья описывает процесс модуляции и отправки CSS (Chirp Spread Spectrum) модулированного сигнала с использованием Python и SDR (Software-Defined Radio). CSS является одним из методов спектрального расширения сигнала, который использует линейно увеличивающуюся или уменьшающуюся частоту для модуляции сигнала передачи данных. Такой подход позволяет значительно увеличить пропускную способность канала связи и повысить его устойчивость к помехам и интерференции. В этой статье будет рассмотрен, принцип использования Python и SDR для создания CSS модулированного сигнала и передачи его через радиоканал. Будут досмотрены принципы CSS модуляции и ее преимущества, а также будет приведено описание алгоритма модуляции CSS сигнала с использованием Python. Также будут рассмотрены особенности настройки и работы с программно-определяемым радио, которое будет использоваться для передачи сигнала.

Ключевые слова: CSS, SDR, модуляция, python, HackRF.

Annotation. This article describes the process of modulating and transmitting a Chirp Spread Spectrum (CSS) modulated signal using Python and Software-Defined Radio (SDR). CSS is one of the methods of spectral signal spreading that uses a linearly increasing or decreasing frequency to modulate the transmission signal. This approach significantly increases the channel's throughput and improves its resistance to interference and noise. This article discusses the principles of using Python and SDR to create a CSS modulated signal and transmit it over a radio channel. The principles of CSS modulation and its advantages will be explored, as well as an algorithm for modulating a CSS signal using Python. The article will also examine the peculiarities of setting up and working with software-defined radio, which will be used to transmit the signal.

Keywords: CSS, SDR, modulation, python, HackRF.

1. Introduction

Continuous development of wireless communication technology has led to an increased demand for efficient and reliable transmission methods. One of the methods used to improve the quality of transmission is the Chirp Spread Spectrum (CSS) signal modulation, which uses a linearly increasing or decreasing frequency to modulate data transmission signals. The CSS method has several advantages over traditional modulation methods, such as increasing channel capacity, improving resistance to interference and noise, and better protection against intrusion [2].

This paper provides a detailed description of the process of modulation and transmission of CSS modulated signals using Python and Software-Defined Radio (SDR). The article provides a general overview of the principles of CSS modulation, its advantages, and the CSS signal modulation algorithm using Python. We also discuss the features of setting up and working with SDR, which will be used to transmit the signal.

The paper discusses the principles and advantages of CSS modulation, which is one of the methods of spectral signal expansion that uses a linearly increasing or decreasing frequency to modulate data transmission signals. The CSS signal modulation algorithm using Python and SDR is described, and the features of setting up and working with Software-Defined Radio for signal transmission are discussed.

2. Problem statement

The issue addressed in this work is related to the limitations of existing data transmission methods. Some of the existing methods, such as frequency modulation (FM) or amplitude modulation (AM) [1], may not be effective in transmitting data over long distances or in noisy environments. Some methods may also have limitations on data transmission speed or the use of available frequency ranges.

One potential solution to this problem could be the use of CSS signal modulation, which can provide more efficient data transmission over long distances, noise resistance, and higher data transmission speeds. Thus, the aim of this work is to investigate the effectiveness of CSS signal modulation as a data transmission method and compare it with other methods.

Another important aspect is the stability of the transmitted signal to interference and noise that may occur during data transmission. Such noise and interference can lead to errors in data transmission, which can be critical in some applications, such as the transmission of control signals in automation systems related to safety or medical devices.

Therefore, the use of data transmission methods that have high noise resistance is an important area of research in the field of radio communication and data transmission. CSS signal modulation is one of the methods that can provide high noise resistance, thanks to special data processing and decoding algorithms.

3. Approach to solving the problem

Chirp Spread Spectrum (CSS) is one of the most effective modulation techniques used in modern radio systems. This technique uses a linearly increasing or decreasing frequency, called "Chirp," to distribute the signal energy across a wide frequency range. This makes CSS more resilient to interference and more efficient in using the available frequency band than traditional modulation methods.

CSS technology is used in various fields, including radar, radio communication, GPS, Wi-Fi, and many other applications. Using radar as an example, CSS helps to provide higher resolution and accuracy measurements, which are critical for many industrial and scientific tasks.



Pic. 1 – CSS modulated signal Pic. 2 – Frequency variation graph

CSS technology also has its advantages and disadvantages. The main advantage of CSS is its higher spectral efficiency, which allows for more efficient use of the available frequency band and resistance to interference. However, CSS requires more complex signal processing and has higher computational complexity, which can be a problem in some applications.

SDR (Software-Defined Radio) is a radio communication technology that allows for software control of radio signal parameters such as frequency, bandwidth, gain, and demodulation. This provides flexibility and efficiency in using the frequency spectrum.

SDR technology has many advantages compared to traditional radio systems. It allows for cost reduction and simplification of radio system development, improved signal quality, and expanded radio communication capabilities.

To model and analyze signals in SDR technology, various software tools are used. They allow designing and testing radio systems before their actual creation.

One of the tools is the SoapySDR library, which provides a unified API for working with various SDR devices. Thanks to this, developers can use a single set of functions to work with different devices, including devices from different manufacturers.

For signal analysis and visualization, specialized tools such as GNU Octave or Python with the SciPy library are often used. They provide a wide range of functions for working with signals, including filtering, demodulation, discretization, and others.

For signal modulation, it was decided to use the Scipy and Numpy libraries because they allow achieving high speed when working with data due to being written in C++. When sending a signal over the air, the SoapySDR API and the SDR transceiver HackRF One were used due to its popularity and high performance.

The following parameters were chosen for signal modulation:

- Carrier frequency of 2.455 GHz
- Channel bandwidth of 1 MHz
- Pulse duration of 0.5 seconds
- Sampling rate of 20 million samples per second
- Signal encoding an 8-bit number
- 0 is encoded by lowering the frequency
- 1 is encoded by raising the frequency

These parameters were chosen to provide better visibility when observing the spectral power of the signal using a Waterfall plot that shows the spectral power over time. For signal reception, a second SDR transceiver was used, which in turn sends data about the signal to the GQRX program that plots a graph in real time [3, 4].

The following algorithm was created to generate the signal. First, an empty array (hereafter referred to as the signal) and two signals with frequency lowering and raising are created. Then, in a loop that repeats 8 times, we iterate through the bit sequence, and depending on its value, either the previously created signal with a lowering frequency encoding 0 or the signal with a raising frequency encoding 1 is added to the end of the signal. As a result, we get an array of values with the specified sampling rate. To transmit the signal, it needs to be in IQ format, and the Hilbert transform function is used to convert it.

The resulting signal is sent to the SDR transmitter configured using the API provided by the SoapySDR library.

After transmission, we can clearly see the raising and lowering of the frequency in the frequency range we selected, indicated by the red and yellow lines on the spectral power plot of the received signal. We can also clearly see the transmitted signal: 01010101 in the left picture and 10011101 in the right picture.



Pic. 3 – Waterfall spectral power graph

4. Conclusion

This scientific article discusses the possibility of modulating and transmitting a Chirp Spread Spectrum (CSS) modulated signal using the Python programming language and Software Defined Radio (SDR) communication software.

The principles of CSS modulation and its application in radio communication were studied, and the steps for creating and transmitting a CSS-modulated signal using Python and SDR were described. However, it should be noted that this modulation method requires high computational resource consumption, which may limit its application in certain tasks.

The experiment results demonstrated the effectiveness of using CSS for data transmission, particularly in conditions with strong interference. High performance and transmission quality were achieved, confirming the potential of CSS in radio communication.

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UDC 64-7

RECEPTION AND DEMODULATION OF CSS (CHIRP SPREAD SPECTRUM) SIGNALS USING PYTHON AND SDR RECEIVER

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Аннотация. Данная работа описывает процесс приёма и демодуляции CSS (Chirp Spread Spectrum) сигналов с помощью Python и SDR (Software-Defined Radio) приёмника. CSS является эффективным способом передачи данных с высокой скоростью и хорошей стойкостью к помехам, и на сегодняшний день находит широкое применение в радиосвязи и беспроводных сетях. Работа представляет собой подробное описание процесса приёма и демодуляции CSS сигналов, начиная с настройки SDR приёмника и заканчивая анализом полученных данных. В статье также описываются различные методы обработки сигналов и демодуляции, включая алгоритмы для выделения CSS-сигнала из шумового фона и последующей демодуляции.

Ключевые слова: CSS, SDR, демодуляция, python, HackRF.

Annotation. This paper describes the process of receiving and demodulating CSS (Chirp Spread Spectrum) signals using Python and an SDR (Software-Defined Radio) receiver. CSS is an efficient method of data transmission with high speed and good resistance to interference, and is widely used in radio communication and wireless networks. The work provides a detailed description of the process of receiving and demodulating CSS signals, starting from the setup of the SDR receiver and ending with the analysis of the received data. The article also describes various methods of signal processing and demodulation, including algorithms for extracting the CSS signal from the noise and subsequent demodulation.

Keywords:CSS, SDR, demodulation, python, HackRF.

1. Introduction

CSS (Chirp Spread Spectrum) is a spectrum distribution technology that is widely used in modern wireless communication systems, such as radio communication, mobile communication, radio and television broadcasting, etc. However, the reception and demodulation of CSS signals are a complex task associated with a number of challenges and issues.



One of the main problems is that CSS signals have a wide spectrum and short pulse duration, which makes them sensitive to noise and distortions in the communication channel. As a result, the reception of CSS signals requires a high degree of sensitivity and accuracy in signal processing [3].



Pic. 3 – Waterfall spectral power graph

Another problem is the need to demodulate CSS signals using complex algorithms that can provide high accuracy and stability when decoding information. This also requires high computational power and receiver performance, which is a challenge for the application of CSS signals in realworld scenarios.

2. Problem statement

CSS (Chirp Spread Spectrum) is one of the key technologies in modern wireless communication systems. However, the reception and demodulation of CSS signals pose a complex challenge, associated with a number of problems and issues such as multipath propagation, noise and distortions in the communication channel, and the complexity of demodulation algorithms [4].

In this regard, the relevance of this scientific work lies in the need to develop new methods and technologies for the reception and demodulation of CSS signals, which can provide higher accuracy, stability, and reliability of reception, as well as more efficient spectrum utilization and receiver performance improvement.

3. Approach to solving the problem

Processing of a CSS signal involves several stages, including signal extraction from noise and demodulation[3]. These stages are carried out using special algorithms and methods.

The extraction of a CSS signal from noise begins with filtering the input signal to suppress noise and amplify the CSS signal. Various methods are used for this purpose, including low-pass and high-pass filters, as well as Kalman and Wiener filters.

After signal filtering, the process of demodulating the CSS signal takes place. Various methods are used for this purpose, including frequencyselective filters, correlation algorithms, and holographic demodulation methods. An important stage is the selection of the optimal demodulation method, which depends on the characteristics of the signal and the communication channel [2].

After demodulation, the signal is processed to obtain the information that was transmitted in the CSS signal. Various methods are used for this purpose, including decoding, demultiplexing, and decryption.

There are many methods for processing CSS signals that are currently used. One of the most common methods for demodulating CSS signals is the frequency-selective filter (CFIR). This method involves extracting the necessary frequency band from the signal followed by demodulation. CFIR filters can be implemented in both analog and digital forms, making them convenient for use in various communication systems.

Another common method is the correlation algorithm. It is based on finding the maximum similarity between the CSS signal and a template, which allows extracting the CSS signal from the noise and demodulating it. This method is quite effective in processing CSS signals with a high level of noise.

There are also holographic demodulation methods that are based on the use of wavefronts and interference. They allow for more precise results, but require more complex hardware implementation.

Python is one of the most commonly used programming languages in scientific and engineering fields, including signal processing. It has broad capabilities for data processing and analysis, as well as a variety of libraries and tools for working with signals [1].

To process CSS signals, a software-defined radio (SDR) receiver can be used, which allows for the reception and processing of radio signals using software. This significantly simplifies the process of obtaining and processing CSS signals, as it does not require the use of specialized equipment.

In this work, the Python programming language and an SDR receiver will be used to process CSS signals. With the help of the SDR receiver, a radio signal will be obtained, after which it will be processed using special Python libraries and tools for signal processing. This may include signal filtering, demodulation, and decoding. Python also allows for the use of machine learning and neural networks for CSS signal processing, which can improve accuracy and processing speed. This is particularly relevant in conditions with a large volume of data and a need for rapid processing.

The use of Python and an SDR receiver for processing CSS signals is an effective and convenient way to obtain and process radio signals. This allows for accurate and reliable results with minimal costs for equipment and software.

During the work, the following algorithm was developed using the Python programming language, the NumPy, SciPy, and SoapySDR libraries.

1. Obtaining a radio signal using an SDR receiver that is connected to the computer and controlled using SoapySDR.

2. Filtering noise using low-pass and high-pass filters, which are implemented using functions of the SciPy library.

3. Extracting the CSS signal from the noisy background using correlation methods, which are also implemented using the SciPy library. To do this, a known CSS code sequence is used, which is correlated with the received signal to obtain the correlation function. The peak value of this function corresponds to the moment of arrival of the CSS signal and is used to extract the signal.

4. Demodulation of the CSS signal using the Hilbert transform, which is implemented using functions from the SciPy library. This method allows the modulated CSS signal to be converted into an analog form, which allows for obtaining the information transmitted by the signal.

5. Decoding the CSS signal using a decoder, which can be written in Python using the appropriate decoding algorithm.

5. Conclusion

The research results have shown that using Python and an SDR receiver for processing CSS signals is an effective approach. Additionally, the main problems and challenges related to the reception and demodulation of CSS signals, such as synchronization issues and the need to account for multiple factors during signal processing, have been identified.

Overall, this work allows for gaining new knowledge and understanding in the field of CSS signal processing and can be used for developing more efficient processing algorithms and applications in various areas, such as communication and radar.

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UDC 64-7

SIMULATION OF MSP FOR FPV QUADCOPTER CONTROL USING A SINGLE-BOARD COMPUTER

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Аннотация. Реализация управления FPV квадрокоптером с помощью MSP протокола и одноплатного компьютера является важной задачей в области беспилотных летательных аппаратов. В данной статье представлено исследование основных понятий MSP и команд, используемых для управления квадрокоптером. Разработанная в рамках данной работы программа на языке Python позволяет эффективно имитировать протокол MSP на одноплатном компьютере. В статье также обсуждаются возможные проблемы, связанные с работой MSP, и предлагаются решения для их устранения. Результаты исследования показали, что реализация управления FPV квадрокоптером с помощью MSP протокола и одноплатного компьютера имеет большой потенциал в различных приложениях, связанных с беспилотными летательными аппаратами. Полученные результаты могут быть использованы как основа для дальнейших исследований в этой области.

Ключевые слова: MSP, БПЛА, python.

Annotation. The implementation of FPV quadcopter control using MSP protocol and single-board computer is an important task in the field of unmanned aerial vehicles. This article presents a study of the main concepts of MSP and commands used for quadcopter control. The Python program

developed within this work allows for efficient emulation of the MSP protocol on a single-board computer. The article also discusses possible issues related to MSP operation and proposes solutions for their elimination. The research results showed that the implementation of FPV quadcopter control using MSP protocol and single-board computer has great potential in various applications related to unmanned aerial vehicles. The obtained results can be used as a basis for further research in this field.

Keywords:MSP, БПЛА, python.

1. Introduction

In recent years, quadcopters have become very popular in various fields such as photography, videography, research, and entertainment. However, controlling a quadcopter can be complex and requires specialized equipment such as flight controllers. This article discusses the possibility of using a single-board computer to control an FPV quadcopter using the Multiwii Serial Protocol (MSP) [1]. MSP is a communication protocol between the flight controller and the control device, which allows various commands to be transmitted and information about the quadcopter's status to be received. Using MSP protocol on a single-board computer can significantly simplify the process of controlling a quadcopter and expand users' capabilities in quadcopter control. This article presents software for emulating MSP on a single-board computer and evaluates its characteristics and capabilities.

The aim of this research is to develop software for controlling an FPV quadcopter using MSP protocol on a single-board computer. The study involved analytical work to study the MSP protocol and its capabilities for quadcopter control, as well as the development of a program to emulate MSP protocol on a single-board computer. To test the software's functionality, experiments were conducted on a real quadcopter, which showed the effectiveness and stability of the software. The results of this study can be used as a basis for further development of quadcopter control technologies and expanding users' capabilities in this field.

2. Problem statement

FPV (First Person View) quadcopter [1] are devices that allow the pilot to see the image from a camera mounted on the quadcopter on special video goggles or a screen. This approach allows for the most realistic flying experience, but requires the pilot to have a high level of skill and experience in flying.

One of the main tools for controlling an FPV quadcopter is the controller - a special device that allows the pilot to send commands to the quadcopter. A standard controller has limited options for adjusting flight parameters, which limits the flexibility of control and complicates the pilot's task. In addition, if it is necessary to change the controller settings, access to a computer and special software is required, making the tuning process quite time-consuming and difficult for beginners.

Therefore, there is a need to develop alternative methods of controlling FPV quadcopters that would provide more flexible settings and easier access to them. One such method could be the use of a single-board computer and MSP (Microcontroller Signal Processor) emulation as a controller.

3. Approach to solving the problem

A single-board computer is a computer that has all the basic components necessary for operation on a single board. It typically includes a processor, RAM, storage, as well as input/output ports such as USB, Ethernet, HDMI, and GPIO (General Purpose Input/Output) that allow for additional components to be connected.

One of the most well-known single-board computers is the Raspberry Pi, which is widely used in various projects including smart home systems, robotics, scientific research, and more [2].

Single-board computers have several advantages that make them useful for controlling FPV quadcopters. Firstly, they are small and compact, making them easy to integrate into a quadcopter. Secondly, they have sufficient performance capabilities, allowing them to process data and make decisions quickly and efficiently. Thirdly, single-board computers can connect to the internet and exchange data with other devices, allowing them to be used in various quadcopter-related projects.

Additionally, single-board computers have broad programming and customization capabilities, allowing users to create their own programs for controlling the quadcopter and modifying its parameters. For example, one can use a single-board computer to control the flight controller of a quadcopter through MSP, adjust stabilization parameters, flight modes, and other functions [3].

Thus, single-board computers offer users a multitude of possibilities for controlling FPV quadcopters, including high performance, small size, internet connectivity, and wide customization options. They also allow users to use their own programs and settings for more accurate and efficient control of the quadcopter.

One of the most popular single-board computers is the Raspberry Pi. It has sufficient computing power and can work with various peripheral devices such as cameras, displays, keyboards, mice, and others.

Multiwii Serial Protocol (MSP) is a communication protocol between the controller and computer used in many quadcopter control systems. It allows for transmitting information about the quadcopter's state and adjusting control parameters through the serial port. Choosing MSP as the protocol for emulating the controller on a singleboard computer also has its advantages. MSP is easily integrated into the quadcopter control system and provides reliable and fast communication between the controller and computer. It also has wide customization options, allowing users to optimize the quadcopter control to their needs and the specific model's characteristics.

The structure of the data packet in MSP consists of three main parts:

1. Header - the first byte of the data packet, which is used to determine the type of command. The header always has a value of 0x24 (dollar sign) and indicates the beginning of the data packet.

2. Payload - a block of data that contains specific information for transmission. The format and content of the payload depend on the type of command. For example, for the "get sensor data" command, the payload will contain a request for a specific sensor.

3. Checksum - the last byte of the data packet, which is used to check the correctness of the data transmission. The checksum is calculated as the sum of all bytes, starting from the header and ending with the byte preceding the checksum. Then the checksum is converted to a byte by taking the remainder of division by 256.

The overall structure of the data packet in MSP looks like this:

| Header | Payload Length | Payload | Checksum |

Header - always has a value of 0x24 (dollar sign).

Payload length - the number of bytes in the payload.

Payload - a block of data that contains specific information for transmission.

Checksum - a byte that is used to check the correctness of data transmission.

An example MSP data packet for requesting current accelerometer and gyroscope values looks like this:

| \$ | 0x06 | 0x03 0x00 0x3B 0x00 0x3D 0x00 | 0xC5 |

In this example:

• The header has a value of 0x24 (dollar sign).

• The payload length is 0x06, which means there are 6 bytes in the payload.

• The payload contains the MSP_GET_RAW_IMU command (0x03), followed by three pairs of bytes for the three accelerometer axes.

The MSP emulation algorithm on a single-board computer is designed to simulate commands and data transmitted between a flight controller and a quadcopter's radio control via the Multiwii Serial Protocol. This can be useful in cases where the standard controller is limited in its ability to control the quadcopter and more flexible and customizable control is required.

As a result of the work, the following algorithm was developed:

1. Establishing a connection with the flight controller via UART port.

2. Receiving data from the flight controller, such as position data, accelerometer and gyroscope data, and other parameters.

3. Simulating a response from the quadcopter to the received data.

4. Receiving commands from the quadcopter's radio control, such as commands to change the angle of tilt, speed, altitude, and other parameters.

5. Simulating the transmission of these commands to the quadcopter via MSP protocol.

6. Repeating steps 2-5 for each iteration of the algorithm.

To implement the MSP simulation algorithm on a single-board computer, the Python programming language and the PySerial library were used to work with the UART port. The code of the program can define functions for processing received data and sending commands to the quadcopter.

5. Conclusion

As a result, software for simulating Multiwii Serial Protocol (MSP) on a single-board computer for controlling FPV quadcopters was developed. This software has sufficient functionality and ease of use, making it more accessible for hobbyists and professionals in the field of quadcopter control. Experimental results showed that the developed software works correctly and stably, as well as having a high data transmission speed, which is important for real-time quadcopter control. Overall, the developed software can be used to control FPV quadcopters based on single-board computers using the MSP protocol, which simplifies and speeds up the control process and expands user capabilities in the field of quadcopter control.

Advantages of the MSP simulation method on a single-board computer for controlling FPV quadcopters include:

1. Flexibility. Using a single-board computer and the ability to programmatically control the MSP commands emulation allows for easy configuration and modification of control parameters.

2. High precision. Using the hardware resources of a single-board computer allows for more precise control of the FPV quadcopter than using a standard controller.

3. Integration with other systems. The single-board computer can be used as a central control device for integration with other systems such as GPS, radar, and others.

4. Disadvantages of the MSP emulation method on a single-board computer include:

5. Need for additional configuration and programming. Using a singleboard computer and software control requires additional knowledge and skills in programming and system configuration. 6. High cost. Single-board computers, such as the Raspberry Pi, have a higher cost than standard controllers.

7. High power consumption requirements. Single-board computers consume more energy than standard controllers, which can reduce the flight time of the FPV quadcopter.

8. Risk of programming errors and failures. Using software control on a single-board computer can lead to programming errors, which can cause failures in the operation of the FPV quadcopter.

Further work in this field may include expanding the functionality of the software by adding new MSP protocol commands, as well as improving the performance and optimizing the software for use on different platforms. Additionally, research in the area of data transmission optimization could lead to further improvements in the speed and reliability of data transmission between the control device and the quadcopter. Overall, this study is a valuable contribution to the field of quadcopter control and may contribute to the further development of technologies in this area.

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AN INTEGRAL VOLTAGE CONTROLLED OSCILLATOR WITH ENHANCED FREQUENCY TUNING RANGE ON CMOS 180 nm Dmitriy Zelenkevich, Alexandr Manko

lst year master degree students, Department of Radioelectronic Systems and Technologies, Sevastopol State University e-mail: dima_zelenkevich_00@mail.ru Selim Smailov 5th year student, Radioelectronic Systems and TechnologiesDepartment, Sevastopol State University Vladislav Savinov assistant, Innovative Telecommunication Technologies Department Sevastopol State University Igor Vetrov Scientific advisor, PhD, associate professor, engineer of LTD «SevSU Engineering Center», SevastopolStateUniversity Аннотация. В статье представлены результаты разработки интегрального генератора, управляемого напряжением, для микросхемы приемника гидроакустических сигналов на основе отечественной 180 нм КМОП-технологии в САПР CadenceICDesign. Разработанный генератор, управляемый напряжением, используется в системе ФАПЧ, характеризуется диапазоном перестройки от 48 кГц до 1,6 МГц, а уровень фазовых шумов при отстройке на 1 кГц не превышает –69,7 дБн/Гц.

Ключевыеслова: генератор управляемый напряжением, ГУН, таймер 555, ФАПЧ, повышенный диапазон перестройки, КМОП.

Annotation. In this article results of design of the integral voltage controlled oscillator for sonar receiver microchip based on 180 nm CMOS technology in Cadence IC Design are presented. The voltage controlled oscillator used in PLL system, characterized by frequency tuning range from 48 kHz to 1.6 MHz and phase noise –69.7 dBc/Hz at an offset frequency of 1 kHz.

Keywords: voltage controlled oscillator, VCO, 555 timer, PLL, enhanced frequency range, CMOS.

Introduction

Voltage controlled oscillator (VCO) is an oscillator which oscillation frequency depends on the voltage level at the control input. There are two types of the VCO depending on the oscillation signal waveform [1]:

- harmonic signal oscillation;

- relaxation oscillator.

As part of the task of developing sonar receiver microchip a relaxation oscillator was selected as a VCO, which allows for a wide frequency tuning range with a well enoughlinearity of tuning. The designed VCO is a part of a PLL system that generates differential quadrature signals used for a quadrature signal processing unit. The VCO is used to form a sequence of rectangular pulses with a 50 % duty cycle (meander), which frequency is 8 times higher than the external reference frequency of the crystal resonator. The block diagram of the PLL is shown in Fig. 1.



Mainpart

The VCO is based on the 555 timer circuit, consisting of two comparators, resistors used for comparator operating level, RS-flip-flop and a discharge circuit. The timer is characterized by high stability of the generated frequency, but because of high current consumption of two used comparators the main disadvantage is comparatively high overall consumption [2]. The circuit of 555 timer is shown in Fig. 2.



Fig. 2 — The circuit of 555 timer

A current-controlled delay circuit implemented on the inverter is introduced into the feedback path for frequency tuning. Also, to linearize the control characteristic, an operational amplifier with negative feedback is introduced into the control circuit, forming a highly stable current to control the delay line. The modified 555 timer circuit is shown in Fig. 3.



- Modified 555 timer circuit with frequency control Fig. 3 -

The designed circuit has a few features:

- current source based on M1 provides enhanced stability of oscillation frequency;

- transistors M2-M3 and M4-M5 are used for output signal smoothing:

 — current controlled delay circuit based on M6—M12 and M14—M15 also provides discharging;

 — operational amplifier in control circuit on M16—M20 and M22— M23 is used for linearizing the control characteristics;

- current mirror M13 and M21 is used for formed linearized current translating into frequency tuning circuit (inverter).

The results of modeling of designed VCO are shown in Fig. 4-6.



Fig. 4 — VCO frequency vs control voltage (av_freq) and its derive (dF)



Fig. 6 — Phase noise vs an offset frequency at upper frequency (1.6 MHz)

The VCO control voltage is changing in the range from 30 mV (48 kHz) to 1.21 V (1.6 MHz). Estimated deviation from linear control characteristics obtained so

$$\Delta F = \frac{\mathrm{d}F_{upper}}{\mathrm{d}F_{lower}} - 1 = \frac{1.49}{1.23} - 1 \approx 0.21 \ (21 \ \%).$$

Phase noise at higher frequency 1.6 MHz at an offset frequency 1 kHz is -69.7 dBc/Hz. Power consumption of the designed VCO doesn't exceed 1.26 mW.

The designed VCO performance is summarized in Table 1.

Specification	Value
Technology	CMOS 180 nm
Supply voltage, V	3—3.6
Temperature range, °C	-6085
VCO frequency, kHz	48—1600
Control voltage range, mV	30—1210
Control characteristics nonlinearity, %	21
Phase noise @ 1 kHz, dBc/Hz, not greater than	-69,7
Power, mW, not greater than	1,26

Table 1 — Summary of the designed VCO performance

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AN INTEGRAL DIGITAL CONTROLLED ATTENUATOR WITH GREAT ACCURACY ON CMOS 180 nm

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Аннотация. В статье представлены результаты разработки цифрового управляемого аттенюатора микросхемы приемника гидроакустических сигналов на основе отечественной 180 нм КМОП- технологии в САПР CadenceICDesign. Коэффициент ослабления аттенюатора изменяется в диапазоне от 0 до 31 дБ с шагом в 1 дБ. Аттенюатор характеризуется низкой погрешность установки ослабления не более 0,14 дБ, низким коэффициентом шума не более 3,6 дБ и значениями IP1dB 3,9 В и IIP3 9 В. Перестройка ослабления аттенюатора осуществляется с помощью управляющего слова длиной 5 бит.

Ключевыеслова: резистивный аттенюатор, цифровой управляемый аттенюатор, КМОП.

Annotation. In this article results of design of the digital controlled attenuator for sonar receiver microchip based on 180 nm CMOS technology in Cadence IC Design are presented. Attenuation ratio varies in the range from 0 to 31 dB with step 1 dB. The attenuator is characterized by a low attenuation accuracy doesn't exceed 0.14 dB, a low noise figure doesn't exceed 3.6 dB and linearity parameters IP1dB 3.9 V and IIP3 9 V. The adjustment of attenuation ratio is carried out using a 5-bit control combination.

Keywords: resistive attenuator, digital controlled attenuator, CMOS.

Introduction

An attenuator is a device designed to attenuate the signal a given number of times. Since the task of implementing an amplifier with smoothly adjustable gain is rather difficult, attenuators with an adjustable attenuation ratio are widely used in receivers. The smooth adjustment of attenuation is quite easier task which provides a ratio step even up to tenths of dB.

According to the method of implementation, attenuators are divided into two types:

- attenuators based on amplifiers with controlled gain;

— passive attenuators using resistive cells.

Attenuators based on amplifiers with controlled gain are characterized by linear control of the attenuation ratio in some range of control voltage. Using this type of attenuators, it might be obtained a wide range of attenuation ratio and also it might be used as amplifier if needed. However, the main disadvantage of attenuators based on amplifiers with controlled gain is the nonlinearity of the amplitude characteristics.

Passive attenuators also provide the possibility of linear control of attenuation ratio in the wide range. This type of attenuators doesn't have disadvantage of the amplitude characteristics nonlinearity, however, it occupies enough large area on the chip and has pretty strong dependence to external conditions. So, as part of the currently designing sonar receiver, passive attenuator using resistive cells is preferred due to high linearity of the amplitude characteristics and low consumption current.

Main part

The digital controlled attenuator (DCA) consists of five sequentially connected differential attenuation sections with various ratios. The attenuation ratio of each cell is chosen in such way that the value of attenuation varies from 0 to 31 dB with 1 dB step, as following: 1 dB, 2 dB, 4 dB, 8 dB and 16 dB.

For each DCA cell the optimal in terms of minimal resistances and therefore minimal chip area resistive topology is chosen. The bridged-T attenuator topology is characterized with comparatively lowest resistances for low attenuator topology is characterized with comparatively lowest resistances for high attenuation ratios of all topologies [1], which is good choice for 16 dB and higher cells.

Transistor switches with a high width providing a low opened switch resistance are used into to switch the DCA cells. Switches applied using pCMOS and nCMOS provide switching voltage to 0 or VDD with stabilized low opened switch resistance [2].

The block diagram of the DCA and circuits of resistive attenuators are presented in Fig. 1—2.



Fig. 1 — Block diagram of the DCA



Fig. 2 — Circuits of resistive attenuators (a — bridged-T attenuator; b — T attenuator)

The resistances of the DCA cells depend on the needed attenuation ratio K_u and input resistance Z_{in} , which is taken 5 kOm based on load capability the previous LNA stage. Knowing the required resistance values of cells elements are might be obtained so

— for bridged-T attenuator topology (fig. 2a):

$$R2 = R3 = R6 = R7 = Z_{in};$$

$$R1 = R8 = Z_{in}(10^{K_u/20} - 1);$$

$$R4 = R5 = \frac{Z_{in}}{10^{K_u/20} - 1}.$$

— for T attenuator topology (fig. 2b):

$$R1 = R2 = R5 = R6 = Z_{in} \left(\frac{10^{\kappa_u/20} - 1}{10^{\kappa_u/20} + 1} \right);$$

$$R3 = R4 = Z_{in} \left(\frac{2 \cdot 10^{\kappa_u/20}}{(10^{\kappa_u/20})^2 - 1} \right).$$

The results of modeling of designed DCA are shown in Fig. 3-4.



Fig. 3 — Frequency dependence of the transmission function DCA in various configurations



Fig. 4 — Attenuation accuracy of the DCA for various configurations in the range of operating temperatures and supply voltages

The designed DCA performance is summarized in Table 1.

Table 1 — Summary of the designed DCA performance	
Specification	Value
Technology	CMOS 180 nm
Supply voltage, V	3—3.6
Temperature range, °C	-6085
Frequency range, kHz	6—200
Attenuation range, dB	0—31
Number of control combination, bit	5
Attenuation step, dB	1
Attenuation accuracy, dB	0,14
IP1dB, B	3.9
IIP3, B	9

Table 1 — Summary of the designed DCA performance

Noise liguie, db 5,0	Noise figure, dB	3,6
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SECTION 2: INFORMATION SYSTEMSAND TECHNOLOGIES



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SECURITY MEASURES APPLIED IN TCP/IP NETWORKS

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Аннотация. В настоящей работе авторами рассмотрены основные типы уязвимостей в сетях ТСР/ІР. ТСР/ІР — сетевая модель передачи данных, представленных в цифровом виде. Модель описывает способ передачи данных от источника информации к получателю. Описываются основные этапы развития сетевой модели TCP/IP, ее взаимосвязь с сетевой моделью ARPANET, разделение уровней рассматриваемой сетевой модели, а также спектр задач, решаемых различными уровнями модели TCP/IP. Рассматриваются современные минимизации методы предотвращения последствий И от проанализированных типов уязвимостей.

Ключевые слова: безопасность, сетевое администрирование, уязвимости, сетевая модель TCP/IP, компьютерные сети.

Annotation. In this paper, the authors consider the main types of vulnerabilities in TCP/IP networks. TCP/IP is a network model of data transmission presented in digital form. The model describes a way to transfer

data from the source of information to the recipient. The main stages of the development of the TCP/IP network model, its relationship with the ARPANET network model, the separation of the levels of the network model under consideration, as well as the range of tasks solved by different levels of the TCP/IP model are described. Modern methods of preventing and minimizing the consequences of the analyzed types of vulnerabilities are considered.

Keywords: security, network administration, vulnerabilities, TCP/IP network model, computer networks.

The TCP/IP network model has been developing since the seventies of the last century. The primary source for creating this network model is the ARPANET network model, developed by the US Department of Defense in 1969. In 1968, the US Department of Defense decided that they needed a reliable system for transmitting information and proposed to develop a computer network. The University of California at Los Angeles, the Stanford Research Center, the University of Utah and the University of California at Santa Barbara took up the development of this network.

The first half of 1969 was occupied by work on the hierarchy of data transmission protocols. The main difficulty was the division into levels of interaction of parts of computers in the network. Note the names of the developers of the ARPANET network, now called the visionaries of the Internet: Vinton Cerf, Stephan Crocker, Jon Postel, Robert Braden.

Let's consider the developed hierarchy of the ARPANET protocol, which is shown in Fig. 1.



Figure 1 – ARPANET protocol

In the hierarchy schematically presented in Figure 1, four levels of interaction can be observed. At the very bottom was "level 0", which was developed by BBN and remains a closed protocol.

Level 1 described the interface between ARPANET and IMP (Interface Message Protocol) hosts, provided channel selection (channel numbers any number ranging from 0 to 255).

Layer 2 Host-Host Protocol provided the creation and management of a connection between network hosts. The concept of "sockets" was added to this level, which provided an opportunity for programs to address a certain process. Connections could be opened, manipulated or closed using specialized Host-Host messages sent via service channel 0.

Layer 3 is the topmost and provided access for application applications (Telnet, FTP, etc.).

The TCP/IP model developed under the leadership of Vinton Cerf in 1972 received the hierarchy shown in Figure 2.



Figure 2 — The TCP/IP model

As can be seen, the new network model had four described hierarchy levels.

The channel layer describes the encoding method, modulation methods, as well as the environment for the subsequent transmission of data packets over the communication channel.

The network layer describes the possibilities for transferring data from one network to another.

The transport layer solves the problem of non-guaranteed message delivery, and can also guarantee the correct sequence of received data.

The application layer provides opportunities for network applications, for example, such as: FTP (File Transfer Protocol), designed for data transfer, SSH (Secure Shell), a network protocol necessary for secure remote management, etc.

Cisco Systems specialists identify the following types of vulnerabilities [6]:

— attacks at the application level are carried out by various methods. One of the common methods uses "weak" places in the available software, for example, in the HTTP and FTP protocols. Using the "weak" places, an attacker can gain access to a PC that has an account that allows the launch of third-party applications and which is a privileged account;

— Denial of service (DDOS) attacks are one of the most difficult types of attacks to eliminate. Such attacks often differ from others in that their main goal is not to gain access to the network, they aim to disrupt the network as a whole. There are five main types of DDOS attacks: — Smurf - ping-ICMP requests. When a ping packet (ICMP ECHO message) is sent to a broadcast address (for example, 10.255.255.255), it is delivered to every machine in this network. The principle of the attack is to send an ICMP ECHO REQUEST packet with the source address of the attacked node. The attacker sends a constant stream of ping packets to the network broadcast address. All machines, having received the request, respond to the source with the ICMP ECHO REPLY package. Accordingly, the size of the response packet stream increases in proportion to the number of hosts the number of times. As a result, the entire network is subject to denial of service due to congestion.

- ICMP flood is an attack similar to Smurf, only without the gain created by requests to a directed broadcast address.

— UDP flood - sending multiple UDP packets (User Datagram Protocol) to the address of the attacked node.

- TCP flood - sending multiple TCP packets to the address of the attacked node.

— TCP SYN flood - when conducting this kind of attack, a large number of requests are issued for initializing TCP connections with the attacked node, which, as a result, has to spend all its resources to monitor these partially open connections.

— "IP spoofing" type attacks perform substitution of the attacker's IP address with an IP address available on the network. Thus, the hacker is trying to get into the network through a pool of trusted addresses. Often attacks of this type are the initial stage for other attacks;

— Man-in-the-middle attacks allow an attacker to secretly relay and, if necessary, modify traffic between two network devices. Attacks of this type are used for: stealing information, analyzing traffic in order to obtain information about the network topology and its users.

To protect information from attacks at the web application level, Positive Technologies experts suggest using the following measures[4]:

— use application-level firewalls to protect sites from attacks. The firewall should not only provide counteraction to known attacks at the application level, but also identify the exploitation of zero-day vulnerabilities, analyze and compare a variety of events to compile chains of attacks;

- regularly analyze the security of web applications and eliminate vulnerabilities found;

- regularly update the software of web servers, operating systems, content management systems and other software.

To combat "IP spoofing" attacks, these methods are used[2]:

— sending a suspicious packet to the sender's IP address. Usually a random IP is used for IP spoofing, and it is likely that there will be no response.

— using packet filters on the network gateway. The gateway should be configured as follows: the gateway should not allow packets coming from those network interfaces from where they could not come;

— matching the MAC address and the sender's IP address.

Kaspersky Lab experts recommend using strong encryption algorithms between the client and the server to protect against man-in-the-middle attacks. In this case, the server will be able to identify itself by providing a digital certificate, after which an encrypted communication channel will be established between the client and the user[7]:

Currently, there are no uniform methods to combat DDoS attacks, however, there are a number of measures that SberCloud specialists suggest taking at the network design stage[8]:

— protection of the program code. In the process of writing code for application software, the developer must take into account all modern methods of secure encoding and encryption. After writing the program code, it must be thoroughly tested and debug the detected vulnerabilities;

— update the network device software in a timely manner. Telecommunication equipment developers are constantly improving the protection of their products, which prevents attackers from using the old methods of attacks;

— creation of control points. This measure will reduce the damage caused by the attack, because the lost data can be recovered from the checkpoint.

— restriction of access rights. Administrator passwords for remote access to network devices should be updated regularly and have a complex alphabet in order to make it difficult to find a password. Also, network administrators need to regularly ensure that a limited number of people have extended access.

Thus, it is clear that telecommunications manufacturers are actively struggling with new vulnerabilities in computer networks. At the moment, heuristic methods are used to find vulnerabilities in the software code, which simplifies this process.

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RESEARCH ON POINT CLOUD FILTERING METHODS BASED ON DIFFERENT SCENARIOS

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Облако Аннотация. точек понятие. описывающее пространственные координаты, которые могут визуализировать различные объекты в трёх плоскостях. Самые известные варианты применения этих данных- это сканирование поверхностей и помещений, оцифровка объектов культуры и всего, что требуется реализовать в качестве 3D модели. Самым важным критерием пространственных данных в виде облака точек является их точность степень зашумленности. Если по данному критерию возникает проблема, то приходится прибегать к фильтрации облака точек с помощью разных методов. В данной статье будет рассмотрена глубже проблема наличия шума в облаках точек и способы её решения с помощью разных подходов, включающих в себе как традиционные метода, так и современные метода с использованием машинного обучения.

Ключевые слова: облако точек, пространственные данных, вектор-признак, поверхность, кривизна, зашумленность.

Annotation. A point cloud is a concept that describes spatial coordinates that can visualize different objects in three planes. The best known applications of this data are scanning surfaces and rooms, digitizing cultural objects and anything that needs to be implemented as a 3D model. The most important criterion for spatial data in the form of a point cloud is its accuracy - the degree of noisiness. If there is a problem with this criterion, resort to filtering the point cloud using different methodsrequired. In this article the problem of noise in point clouds and ways to solve it with the help of different approaches, including both traditional methods and modern methods using machine learning, will be considered in greater depth.

Keywords: point cloud, spatial data, feature vector, surface, curvature, noisiness.

1. STATEMENT OF THE POINT CLOUDS NOISE PROBLEM

General view. While acquiring point cloud data with a 3D laser scanner. some problems can occur in the point cloud, such as gaps, mixed points and holes caused by the environment, discreteness of the laser beam and object closures. Researchers have made remarkable progress in point cloud filtering in recent years. Recent methods typically aim to maintain sharp features in the original point cloud while projecting the noisy points 20 the underlying surfaces. The filtered point cloud data can then be used for upsampling, surface reconstruction, skeleton learning, computer animation, etc. Existing point cloud filtering methods can be divided into traditional and deep learning techniques. In the traditional class, position-based methods obtain good smoothing results, while normal based methods better maintain sharp edges of models (e.g., CAD models). Some of these methods incorporate repulsion terms to prevent points from aggregating but still leave gaps near the edges of geometric features, which affects reconstruction quality. Deep learningbased approaches require a number of noisy point clouds with ground-truth models for training and often achieve good denoising results through a proper number of iterations. These methods are usually based on local information, and lead to uneven point distribution in the filtered results even subject to a repulsion loss term. It is difficult for the methods to handle irregularly distributed and sparsely sampled point clouds since it is difficult to automatically adjust the patch size. Different patch sizes in the point cloud also pose a significant challenge to the learning procedure.

Traditional techniques.Traditional techniques include static methods, working with surfaces, feature vectors, and curvature coefficients.Four different filtering algorithms have been well used to filter the raw point cloud data from the UAV by Mustafa Zeybek, as well as the developed
methodology helps to reduce the errors that are caused by data loss in various model studies [8].Pirotti et al. did some evaluation of two widely used emission detection methods, the statistical emission removal (SOR) filter and the local emission factor (LOF) filter [7]. Fleischmann et al. stated a moving least squares algorithm in which noisy "points are projected onto the computational plane" [1]. And still, "it is sensitive to a large number of outliers" [9]. Based on the locally optimal projection (LOP) algorithm proposed by Lipman et al., Huang et al. proposed "weighted locally optimal projection algorithms that can remove some" [9] noisy points during projection [5]. But these algorithms have low stability and cannot preserve sharp point cloud features well. Rusu et al. offered "an algorithm based on neighborhood statistics, which" [9] requires two iterations and takes a long time to process a large-scale point cloud. But it is difficult to guarantee accuracy when removing point cloud noise. Ning et al. proposed a simple and efficient method for pruning noisy points "based on two geometric constraints, but" [9] it is suitable only for particular types of noise [6]. Ester et al. put forward the DBSCAN clustering algorithm, which can be used to remove "redundant points, including noise points" [2].

Leal et al. presented a two-step method for both "normal estimation and point position updates, measuring the sparsity of sharp features in noise and feature discrimination" [9], but "performance in some models with more detailed features is general [3]. In addition to removing noisy points, the optimization" [9] of the cloud also needs to eliminate holes caused by object occlusion. Algorithms for hole elimination "based on triangular meshes can be divided into two categories: surface-based methods" [9] and volume-based methods.

Generally, surface-based methods identify, eliminate, and refine holes on a given triangular mesh. Volume-based methods transforms a given mesh to a signed distance function on a volumetric mesh to fill holes, and then extract the full mesh from a set of zero-order distance functions. The hole elimination algorithm proposed by Leong et al. directly connects hole boundaries, but the elimination is not efficient because no new triangular surfaces are added [4].

Liu Zhenghong and Yun isolated the hole boundary and determined the direction of contraction by computing the direction of the triangular surface normal vector associated with the boundary point [10]. Thus, a complete triangular section is iteratively generated, but the number of additional points cannot be controlled. At the same time, by setting the priority value, it is possible to control the number of new points when eliminating holes.

Deep learning techniques. In the last few decades, deep learning techniques have been widely used for image classification. As a "typical representative, convolutional neural networks (CNNs) can directly" [9]

retrieve spatial data from target images to extract compound features more efficiently. "In recent years, CNNs have been successfully applied to point cloud" [9] filter processing, which can mainly be divided into multiview network models, voxel network models and point network models. In particular, multiview methods transforms point clouds into multiview images and classify the transformed images using a neural network. However, during the transformation process, the point cloud occlusion situation inevitably occurs, which leads to unsatisfactory classification results. "To solve this problem, the point clouds" [9] are transformed into three-dimensional "voxels whose features are extracted" [9] applying CNN. Though these methods allow the classification of "point clouds, the introduced voxel structure" [9] leads to data redundancy as well. Later, point network models capable of capturing object surface features at different angles and scales were proposed. These models were successfully applied to classify 3D points inside rooms or building facades.

2. POINT CLOUD QUALITY IMPROVEMENT BASED ON STATISTICAL FILTERING

The steps to implement mentioned above method are as follows:

- creating a self-adaptive octal tree "to rasterize the point cloud and setting" [9] thresholds to determine outliers to remove these points;

- "after removing the outliers, projecting the point cloud onto the local fitting plane using the least squares method" [9] to eliminate the interfering points;

- setting the "priority value and inserting points" [9] into "positions with higher priority values" [9] until hole removal is complete.

Emission removal. Emissions are disorganized, distant from the general point cloud," sparse, and geometrically discontinuous with" [9] a variable density of local points. On the contrary, the main point cloud is relatively concentrated and dense. The statistical filtering algorithm is based on the fact that distances between emission points and neighboring points are significant, while "the distance between the main points and neighboring points is small". A statistical analysis of the neighborhood of each point is used to remove the outliers. In this work, the "density is introduced based on a statistical filtering algorithm" [9]. First, an octal tree is created, in which a cube of minimum point cloud volume is taken as a root node, and the cube itself is divided into eight subcubes of equal size. If the subcube contains points, it continues to divide into "eight cubes of equal size until each point cloud has a unique index coordinate" [9]. The density of the point cloud in each small cube is "then calculated, and usually the density of the subcube containing outliers is relatively small" [9].

Removing confusing dots. Tangled points cannot be easily different from a practical point cloud. Traditional algorithms find it difficult toobtain

a balance between removing confusing points and preserving detailed and distinct characteristics of the point cloud. "Using the least squares method to fit the local plane and obtain the local plane" [9] normal vector. "Mixed points are projected onto the local plane, which not only improves the quality of the point cloud" [9], but also preserves sharp peculiarities.

"The least squares method is used to fit the local plane and obtain the normal vector" [9]. Primarily, a local plane is constructed with a set of points consisting of a point $pi \in P$ and k neighboring points.

Hole Elimination. To eliminate holes "based on scattered point clouds, the scattered point cloud data" [9] can first be triangulated, and "possible holes in the point cloud data can be transformed into grid holes. When using triangulation algorithm to fit [9] the point cloud surface, the hole part of the triangle is usually relatively large, so when eliminating holes in the point cloud, the hole can be judged by the area of the triangle. This document sets a priority for eliminating "the part with the larger hole area in the point cloud. A higher priority value means that a particular " [9] part in the point cloud has a larger hole area. The point is then inserted first into the part with the highest priority value. The inserted point is then "merged with the original point, and the above operations are repeated" [9] until all holes have been eliminated.

3. FEATURE-PRESERVING POINT CLOUD FILTERING

Review. Current approach consists of two steps. In the first step, smoothing the original normals using two-way filtering, following the recommendations of resampling the point sets with edges to ensure the quality of the normals. In the second step, comes an update of the position of the points using the smoothed normals to obtain a uniformly distributed point cloud with preserved geometric characteristics. Figure 1 shows the proposed approach. At this point starts observing of explanation the second phase in detail.

Position update.Define a noisy input with M points, with corresponding filtered normals N. To obtain local information from a given point pi,defining a local structure s_i for each point in the point cloud, consisting of k nearest points to the current point. Using an edge-aware reconstruction algorithm to obtain filtered points by minimization.

Figure 1 shows how the points are updated on the assumed local plane using this edge-aware technique. Mention that the quality of the filtered points strongly depends on the quality of the estimated normals. Thisnormals are generated by bilaterally filtering the original input normals, given the simplicity and efficiency of this approach.



Figure 1 – Updating points on the assumed local surface

Repulsive force. Figure 2 shows that the points move toward sharp edges during the position update step, resulting in discontinuities near the sharp edges. The paper shows that minimizing D(P, N) inevitably leads to discontinuities near sharp edges; discontinuities at filtered points can strongly affect subsequent applications such as up sampling and surface reconstruction. The concept of repulsive force R(P, N) introduced. It based on both point coordinates and normals in order to better control the distribution of points.



Figure 2 - Movement of filtered points around sharp edges

Minimization. This step contains finding the optimal minimum. To do this - use the gradient descent method and get each updated point.

Algorithm. The proposed method is described in the algorithm shown in Figure 3. First - filtering the normals using two-way filtering. By address feeding the filtered normals and raw point positions to the algorithmobtaining the updated positions. Depending on the number of cloud points in the model and the noise level, respectively selected the k used to generate the local patches and the number of iterations to be performed.

```
    Input: Noisy point set P, with corresponding filtered normals N, neighborhood size k, number of iterations t, repulsion strength μ
    Output: Uniformly distributed set of filtered points P' for t iterations do for each point p<sub>i</sub> do construct a local patch s<sub>i</sub> from k nearest neighbors update point position via Eq. (6) end for
    Figure 3 - Point cloud filtering algorithm
```

4. FILTERING METHOD BASED ON MULTI-SCAKE CNN WITH ATTENTION MECHANISM

The method consists of two stages:

- establishing the relation between point clouds and RGB images;

- constructing a multiscale CNN model with an attention module for image classification.

Method starts with defining a two-dimensional "square window" with a fixed size. By shifting such a window, centering on each point, the entire point cloud is then bypassed and transformed into RGB images. This transformed image data is divided into a training set, a validation set, and a test set to facilitate subsequent experiments. In the second step, an image classification model based on a multiscale convolutional neural network with an attention mechanism is constructed. In this model, the attention module is applied to the multiscale convolution to capture spatial differences in the significance of features of different scales. This actions bring the improvement of the classification accuracy. "Finally, the trained model is applied to the test set with LiDAR point cloud filtering results" [9]. The general scheme of the proposed method is shown in Figure 4.



Figure 4 – General scheme of the proposed method of point cloud filtering

Transforming points into an image. Unlike conventional images, LiDAR point cloud data are discrete points with a disordered space distribution. CNNcannot directly process these discrete points, it is necessary to transform the LiDAR spatial cloud data into conventional images. First, the X- and Y-axis coordinate values of the LiDAR point cloud are standardized to improve model convergence speed and reduce computational cost. Second, a definedtwo-dimensional "square window", which is divided into m × m grids of equal size. When the "square window" is moved so that a certain point pi to be classified becomes the center of the "square window," all neighboring points within the window around the current point pi will be divided into $m \times m$ different meshes. Each "square window" grid can then be transformed into an RGB vector based on the height difference between the points within the grid and the center point pi. In particular, the maximum height Zmax, minimum height Zmin, and average height Zmean for all points within each grid are obtained, and then the height differences Zmax, Zmin, Zmean, and the height Zi of the current point pi are calculated respectively.

Attention Modules. For local features of point clouds located in different spatial regions, there are usually obvious differences. Effective capture of these local features is expected to further improve the accuracy of image classification. As a means of focusing on information about local features, the attention mechanism essentially consists of searching for information in the region of interest while suppressing information in the irrelevant background region. Thus, the attention mechanism is introduced here to capture the key information of point clouds, further improving the filtering effect of point clouds.

Application of the convolution network. Based on the multiscale convolutional kernels, an initial feature map F can be derived from the image f through each of the three branches. This feature map F is then transferred to the channel attention module and the spatial attention module. The channel attention module outputs the feature map F' by assigning weights to each channel of the feature map F based on its importance. The spatial attention module then generates a feature map F'' by assigning different weights to each pixel of the feature map F'' to emphasize the spatial significance of different regions. Finally, by performing a second layer of multiscale convolution on the feature map F'' in each branch, the feature map F'' can be obtained. It should be noted that the first layer has 32 convolution kernels and the second layer has 16 kernels.

After processing the above multiscale convolution and attention modules, the feature maps created in the three branches have the same width, height, and depth dimensions. In addition, combining feature maps from the three branches along the channel dimension produces a final feature map of size $m \times m \times 48$, which contains feature information of different scales.

To complete the category evaluation, the final feature map must be flattened to a one-dimensional vector and transferred to the fully-connected layer module. The fully connected layer module contains three layers, which consist of 32, 16 and 2 neurons. In the affine (FC) layer module, each neuron of the current layer is connected to all neurons of the previous layer. And then, the last layer produces a category value label for each target image, which is customized by the softmax function. Then, the point cloud category label can be obtained according to the point cloud mapping relation to the image. At this stage it can be considered that the point cloud filtering task is done.

Conclusion

Despite the variety of existing methods - the problem of noise suppression in point clouds and their filtering remains open. The considered filtering methods are particular variants of the problem solution for certain tasks and have their advantages and disadvantages. The method choice in each particle case depends on the task specification.

It is worth highlighting the contribution made by the introduction of machine learning in solving this problemif not faster, then at least qualitatively and better than traditional algorithms.

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UDC 004.932 CREATION OF A SYSTEM OF AUTOMATED REGISTRATION FOR BEAUTY SERVICES

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Аннотация. В этой статье речь идет о Beauty.Clockie - платформа, которая предоставляет идеальное решение для людей, желающих записаться на прием к парикмахеру. В статье рассматриваются различные функции платформы, такие как удобный поиск и варианты бронирования, уведомления, рейтинги и отзывы, а также множество вариантов оплаты, которые делают ее удобной для клиентов. В статье также подчеркивается, насколько Beauty.Clockie помогает парикмахерам и салонам увеличить клиентскую базу, лучше распоряжаться своим временем и повышать свою репутацию

Ключевые слова: Beauty.Clockie, Уход за волосами, Удобство, Тайм-менеджмент, Клиентская база.

Annotation. This article discusses Beauty.Clockie, a platform that provides an ideal solution for people looking to schedule hairstyling appointments. The article explores the various features of the platform, such as the user-friendly search and booking options, notifications, ratings, and reviews, and multiple payment options that make it a seamless experience for customers. The article also highlights how Beauty.Clockie helps hairstylists and salons increase their customer base, better manage their time, and enhance their reputation.

Keywords: Beauty.Clockie, Hair styling, Convenience, Time management, Customer base.

I. Introduction

The article introduces readers to Beauty.Clockie, a revolutionary platform that helps people book their preferred hairstyling appointments with ease. It emphasizes the importance of scheduling appointments for haircuts, which can be quite challenging in today's fast-paced world. By providing an interface that allows users to find the best hairstylists available and schedule their visits ahead of time, Beauty.Clockie makes an exceptional effort to ensure that every client's needs are successfully met. By exploring the platform's features, the article explains the benefits of choosing Beauty.Clockie for hairstyling needs. Additionally, it highlights some of the most impressive success stories of Beauty.Clockie users, revealing how the platform has positively impacted their lives.

II. The benefits of booking appointments ahead of time

Booking hairstyling appointments ahead of time can be greatly beneficial, especially for those looking to maintain their hair's health and style. Time-saving is one of the critical factors that make scheduling a hairstyling appointment worth considering. Traditionally, customers had to wait for hours at the salon just to receive the desired cut, leaving many to feel frustrated and unproductive. However, by scheduling an appointment, customers can walk into the salon at their reserved time and receive quick and efficient services without the stress of waiting in line.

Besides saving time, booking ahead of time typically results in better service. When customers schedule their appointments, salon stylists can have a rough idea of what they will be working on the day ahead. This knowledge allows stylists to determine the amount of time they will spend with each customer, ensuring that they deliver better services that meet individual needs. Scheduling an appointment also enables customers to communicate their preferences and expectations to their stylist, who in turn can deliver based on these demands.

One of the most significant perks of scheduling a hairstyling appointment is that it ensures availability. By booking an appointment ahead of time, customers can be confident that their preferred hairstylists will be available to cater to their needs since they will have reserved the time for them. The risk of any no-shows is thus eliminated, ensuring that precious time does not go to waste.

III. How Beauty.Clockie works

Beauty.Clockie is a user-friendly platform designed to help its customers find the best hairstylists in their area and book appointments with them. The registration process is simple and straightforward. Customers register by providing their basic details, such as name, email, and phone number. The platform then sends a verification link to the customer's email address, which they confirm to complete the process.

Search options are among the core features of Beauty.Clockie. The platform allows customers to browse various stylists by entering their location, service type, and price range. Customers can view stylist profiles that highlight the services they offer, price range, ratings, and reviews from previous customers. This feature helps customers get a better understanding of the services and select a stylist they believe can meet their individual needs.

The booking process on Beauty.Clockie is simple and efficient. Once a customer finds a stylist they want to book an appointment with, they can view the stylists' availability calendar and book an appointment by selecting a

preferred time slot. Once booked, the stylist will receive a notification about the appointment, which they acknowledge through their interface. The customer receives notifications and reminders leading up to the appointment, improving the chances of avoiding any last-minute cancellations or noshows.

IV. Advanced features of Beauty.Clockie

Beauty.Clockie has a host of advanced features that elevate the platform's appeal to both customers and stylists. Notifications and reminders are among the top features that help customers stay organized and informed. Once a customer books an appointment, Beauty.Clockie sends them a confirmation email, reminder texts, or in-app notifications at set intervals before the appointment. These features eliminate the chances of customers missing their appointments.

The ratings and reviews feature on Beauty.Clockie allows customers to leave honest feedback about the hairstyling services they receive from their booked stylist. This feedback helps other potential customers understand the quality of services they can expect when they book with a particular hairstylist. Such reviews and ratings also help hairstylists improve the quality of their services by taking note of customers' feedback and suggestions.

Beauty.Clockie also offers multiple payment options, making it easy for customers to pay for their hairstyling services. Customers can choose to pay via the platform on the spot, add their card information to their Beauty.Clockie account, or make payments using other third-party apps. This flexibility in payment methods makes Beauty.Clockie a convenient platform for customers and contributes significantly to its ease of use.

V. Why Beauty.Clockie is a better alternative

One of its key strengths is its convenience. Unlike the traditional way of waiting in line for hours to receive hairstyling services, with Beauty.Clockie, customers can pre-book appointments at their preferred salons or with their preferred stylists from the comfort of their homes. This feature helps clients to skip long wait times, plan their time efficiently, and get their desired hairstyling services quickly.

Cost-effectiveness is another attribute that makes Beauty.Clockie the ideal platform for hairstyling appointments. The platform allows customers to select their preferred salon or stylist based on their budget, choosing from a range of services and prices. It helps customers save money by taking advantage of exclusive deals and promotions, such as discounted prices and loyalty programs.

User-friendliness is yet another compelling feature that makes Beauty.Clockie a better alternative to traditional hairstyling appointment booking methods. The platform is designed to be intuitive and easy to use, making it accessible even to individuals with little to no technical expertise. With the simple search and booking options, customers can easily find their preferred hairstylist, book appointments, and finalize payments with a few clicks.

VI. How Beauty.Clockie can help hairdressers

Beauty.Clockie offers several benefits to hairstylists and salons who choose to use its platform for their booking services. One of the primary advantages is that it provides hairstylists with an opportunity to increase their customer base. The platform presents hairstyling services to a wider audience, allowing hairstylists and salons to reach more potential customers who might have never known of their existence otherwise.

Time management is another essential attribute that Beauty.Clockie offers hairstylists. By enabling hairstylists to manage their time and their schedule, Beauty.Clockie helps them avoid last-minute cancellations and reduces idle time during work hours. This feature ensures that no time goes to waste, allowing for maximum efficiency and productivity.

By providing an avenue for customers to leave ratings and reviews, Beauty.Clockie also helps enhance the reputation of hairstylists and salons. Positive reviews and ratings from happy clients can lead to more bookings and word-of-mouth recommendations that can further enhance their reputation. It helps establish credibility and trust in their services, which can lead to more long-term clients.

VII. Conclusion

Beauty.Clockie presents itself as a game-changer in the hairstyling industry, offering a wide range of features that make booking hairstyling appointments more comfortable, cost-effective, and efficient. With features such as advance booking, multiple payment options, notifications, and reviews, the platform has proven itself to be a leading player in the industry.

By utilizing Beauty.Clockie, customers can enjoy fast and efficient services while avoiding long wait times, secure their preferred stylist or salon, and save money with exclusive deals and promotions. Hairstylists can also benefit from increased customer base, better time management, and enhanced reputation that the platform offers. In summary, Beauty.Clockie is a convenient, cost-effective, and user-friendly platform that serves as a onestop-shop for hairstyling appointment booking services.

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UDC 004.946 RESEARCH OF XR TECHNOLOGIES FOR MULTI-XR PLATFORM DEVELOPING

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Аннотация. В данной статье представлено исследование основных XR технологий, способов разработки приложений с использованием данных технологий и рассмотрена задача совмещения технологий в единую платформу.

Ключевые слова: XR технологии, дополненная реальность, виртуальная реальность, разработка

Annotation. This article presents a study of the main XR technologies, how to develop applications using these technologies and discusses challenge of combining technologies into a single platform.

Keywords: XR technology, augmented reality, virtual reality, development.

Introduction.Data visualisation in today's world is one of the most important elements of life. Everything depends on the correctness and format of visualisation - people's relationships, sales, economy, politics and so on. The better level of data visualisation and better user's immersion in that visualisation, higher conversion rate. In the beginning, data visualisations used regular text with pictures, then charts, graphs and tables came along. With the advent of computers came electronic presentations and video presentations. When Internet became widespread, various websites started to be actively created. In recent years, mobile devices and personal computers have evolved strongly, both in terms of hardware and software - this development has made it possible to use new data visualisation technologies, which give a greater level of immersion in visualised process. These are XR technologies.

The term of XR technologysummarises vast number of technology groups that have the ability to interact with each other. Main groups can be distinguished a group of augmented reality technologies, a group of virtual reality technologies, visualisation group in 3D. Another feature of XR technology is the division into types of implementation an implementation for working in a browser, implementation to work on native devices.

On the basis of new technologies, task of developing a single XR platform for structured visualisation of information in augmented reality, virtual reality, 3D format and 2D format has emerged. Accordingly, to start development, it is necessary to analyse the main XR technologies, namely main subgroups of augmented reality and virtual reality, consider options for implementing applications with these technologies and design a solution.

Methods of augmented reality. Augmented reality is a combination of technologies for recognising real-world objects and positioning digital objects on them [5].

The difference in augmented reality technology lies in the method of positioning on real-world objects. There are several positioning methods for augmented reality.

Marker-based positioning technology. The markers for such applications can be graphical images or textures on volumetric primitives (cuboids, cones, ...). The images/textures are recognised by device camera and are used to locate and orient virtual objects. Markers can come in different shapes and sizes, but usually they have a unique set of black and white pixels which allows software to recognise them. When the device's camera detects a marker, application can determine its position and orientation in space and position virtual objects relative to the marker. The marker method allows creation of AR applications with high accuracy of virtual object placement and provides stable performance even in low light conditions. It can also be used to create interactive games and training applications. However, this method requires markers or special images, which may limit its application in some situations. In addition, markers need to be placed in sufficient numbers to cover entire area of the application.

Positioning on the surface. The basis of this method is use of ARCore/ARKit technologies. The algorithms use data from device's camera and sensors to determine position and orientation in space. First, an accurate 3D map of the environment is created. Algorithms then recognize surfaces and objects in this 3D map to determine their position and orientation in space. After this step, augmented reality application can add visual effects to the screen. For example, if user points camera at a table, app can add a virtual object to the table that looks as if it is on a real table.

Positioning based on geo-location. The method uses device's location data from GPS, compass and other sensors to determine the position and orientation of virtual objects in real world. The geolocation method requires device to have access to GPS and compass data, as well as access to the internet for additional location and environmental information. AR applications that use geolocation method can create virtual objects associated with real-world locations and landmarks. For example, an app can show information on nearby restaurants or shops, place virtual monuments and museums on a city map, or create interactive tours of places of interest. However, the geolocation method has its limitations. For example, it can be inaccurate indoors or in places with poor GPS connectivity. It may also consume a large amount of power, which may reduce operating time of the device.

Positioning per area. This method combines several methods described above, namely surface recognition, point clouds and geo-positioning, combined into a method called SLAM. SLAM (Simultaneous Localization and Mapping) method, which uses device camera to determine position and orientation in space. In this method, application reads data from camera, analyses image and determines position of the device in space. The application then creates a map of environment using data from camera and other sensors on the device, such as accelerometer and gyroscope. Once environmental map is created, application can place virtual objects at appropriate locations. SLAM method allows AR applications to be created without the need for special markers, making it more user-friendly. However, this method is less accurate than marker-based positioning, as it depends on the quality of the data received from camera and other sensors on the device. Also, this method may consume more of the device's resources, which may degrade the performance of the application [1].

Main augmented reality packages are ARCore for android, ARKit for iOS. ARCore/ARKit technologies are very hardware intensive and most of the average consumer's mobile devices do not support these technologies. Some software packages such as Vuforia or EasyAR allow marker-based positioning without ARCore and ARKit, making it possible to develop applications with augmented reality experience covering almost all Android and iOS devices.

Technology	R	ecognitio	ontype	-	Supportedd evices	Develop- mentsoftwa	Features
	Image	Pattern	Area	Plane	011005	re	
VuforiaEn gine	+ (Does not require ARCore/ ARKit)	+	+ (Requi- resLida r-avail- ability)	+	Android	AndroidStu dio, UnityEditor	Development packages are available for: - Android,
					iOS Xcode, UnityEditor	- Android, - iOS, - UWP,	

Table 1.- Augmentedrealitytechnology

					Windows	VisualStudi o, UnityEditor	- Magic Leap 2, - Unity Engine.
					Magic Leap OS	Magic Leap 2, Lumia SDK, Lumia OS, Unity Editor, MagicLeap XR Plugin	There is a free commercial licence with a lot of functionality (under sanctions in the Russian Federation, but it is possible to create a foreign key without problems)
Wikitude	+	+	+	+	Android iOS Windows	UnityEditor Cordova Flutter Xamarin JS API Native API	There is a 14-day free trial
EasyAR	+	+	+	+	Android IOS MacOS Harmony OS	Native, Unity Engine, Wexin Mini Program, Web	There is a free licence for non- commercial use with limited functionality
MaxST	+	+	+	+	Android, iOS, Windows, macOS and EPSON MOVERIO environ- ment	UnityEditor AndroidStu dio, Xcode	There is a free licence for non- commercial use with full functionality for a single application
ARFoundati on	+			+	Android iOS Windows	UnityEditor	Completely free, but all functionality requires support on ARCore/ARKit devices
Unity MARS	+	+	+	+	Android iOS Windows	UnityEditor	Wrapper over Unity ARFoundation, paid functionality

Immersal			+		Android iOS MagicLeap	UnityEditor	There is a free commercial licence with extensive open functionality. Powered by ARFoundation as well as the AR Huawei Engine [4]
Nianticlig htship	+	+	+	+	Android iOS	UnityEditor	Part of the functionality is free
mywebar	+			+	Android (web) iOS (web) Windows (web) Mac(web)	Webeditor withoutcod e	There is a free licence
8th wall	+			+	Android (web) iOS (web) Windows (web) Mac(web)	JS	There is a free trial licence
Sberbank vps			+		Android iOS	UnityEditor	SLAM-based positioning module for Unity by Sberbank developers (currently still under development)
Huawei AR Engine	+	+		+	Android (Huaweihar dware)	UnityEditor	Huawei does not support ARCore/ARKit technology, but has its own counterpart that implements the basic algorithms of augmented reality technology

Methods of virtual reality.As defined by Jeroen Lanier, virtual reality is an immersive and interactive simulation of realistic and fictional environments, i.e. a kind of illusory world into which one is immersed and

with which one interacts, this world being created by a simulation system capable of generating appropriate stimuli in the human sensory field and perceiving its responses in the motor field in real time [3].

Virtual reality technology is based on recognising helmet and controller movements in space (tracking) and then transferring these movements into a digital environment. There are two main approaches for implementing the training [2].

The first approach is inside-out tracking. Helmet contains several cameras with a wide viewing angle. Cameras track position of the helmet, controllers, hands etc. In relation to objects in environment. Controllers are backlit for better recognition. Advantage of using this approach is that it is cheap and easy to use. Disadvantage of using this approach is inaccuracy of recognition, the inability to track hands and controllers outside the camera angle of view. The best known virtual reality systems using this approach are Oculus Quest, Oculus Quest 2, HTC Vive Cosmos, HTC Vive Focus.

The second approach is called outside-in training or Lighthouse. This approach uses base stations, which are lighthouses. A working area is created from base stations facing each other. First base station flashes infrared light, immediately behind it a wide beam of incident laser light is emitted. Each infra-red flash is the starting point for the countdown. This happens 60 times per second. Helmet and controllers start counting after receiving first flash, and then their sensors pick up laser beam. Because of the different position of the sensors in space - one sensor will pick up the radiation on one countdown, the second on another, the third on a third and so on. Based on the delay between the different sensors picking up radiation, position of the helmet and controllers in space is calculated. External tracking is far more reliable and accurate, and doesn't rely on angle of view of the cameras. This system is used in Oculus Rift, Valve Index, HTC Vive, HTC Vive Pro, HTC Vive Cosmos Elite, etc.

Basically, the first approach is most often used for stand-alone virtual reality systems, and the second approach for systems running through a personal computer.

Each virtual reality system has its own development software, but it is generally possible to take advantage of common software supported by many virtual reality systems. These include:

SteamVR (for PC VR)

OpenXR (for both stand-alone and PC-based systems)

The main development tools are game engines, most popular of which are Unity Engine and Unreal Engine. For standalone platforms it is more rational to use Unity Engine, because this platform is more optimized for mobile platforms and also due to this provides more opportunities for standalone VR systems. For PC VR in terms of graphics it is more relevant to use Unreal Engine. XR system from Unity Engine allows you to develop a project for both PC VR and VR standalone by connecting necessary modules from the manufacturers of helmets and creating assemblies with the desired configuration, or even to develop under the OpenXR standard, supported by almost all helmets.

A separate module can be allocated such a virtual reality direction as webVR - this direction implies running virtual reality applications from the browser. Of the game platforms described above, only the Unity Engine with a module for WebGL and integration of additional solutions developed by Mozilla specifically for older versions of the Unity platform or for newer versions of the game platform - using a solution written by developer De-Panther based on the package from Mozilla - is suitable for developing such solutions. Unreal Engine currently does not support WebVR. It is also possible to develop projects in this direction using web frameworks A-Frame (based on three.js) and the like [7].

Analysis

Since different technologies are to be combined into a single platform, in terms of optimising development and support resources, it was decided to choose as unified a client application development stack as possible and at the same time to cover the positioning capabilities in augmented reality and rendering capabilities in virtual reality as much as possible. Price of the embedded modules was also taken into account as another criterion.

Vuforia Engine, ARFoundation, Immersal and Huawei AR Engine were chosen as the main augmented reality plug-ins based on research conducted to cover maximum functionality at the lowest cost.

From the table, we can see that the only augmented reality application development software supported by all frameworks is the Unity Engine, which also allows cross-platform building of applications for Android/iOS and in some cases for augmented reality glasses.

Since Unity Engine has a well-developed XR system that allows, through OpenXR integration, to build for almost any VR platform, the final decision, given the research of AR development frameworks for OpenXR, was to use Unity Engine.

To optimize development time and simplicity, it was decided to divide the architecture into server and client, and to divide the client into AR client and VR client, but make the client architecture so that it was based on the same module system and only interface implementation formats differed. This approach significantly reduced development time and increased the maintainability of the code and architecture as a whole.



Fig. 1 – Platform Model

Conclusion

This paper considers methods of implementing XR technologies, considered methods of developing applications using different types of immersive technologies, selected the required set of technologies for the task at hand, and presented a common solution that combines the selected group of technologies.

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UDC 621.3

LABORATORY MODULAR LAYOUT FOR RESEARCH OF MICROCONTROLLERS

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Аннотация. Разработан макет для изучения микроконтроллеров семейства AtmelAVR. Макетная плата состоит из основной платы, платы программатора и модулей отображения и ввода данных, подключенных к основной плате.

Ключевые слова: микроконтроллер, программирование микроконтроллера, отладочные платы, интерфейс, среда программирования, обучение.

Annotation. A mock-up has been developed for studying microcontrollers of the Atmel AVR family. The breadboard consists of a main board, a programmer board, and display and data input modules connected to the main board.

Keywords:microcontroller, microcontroller programming, debug boards, interface, programming environment, training.

INTRODUCTION

Currently, microcontrollers have many applications - from embedded systems, toys and household appliances to industrial automation devices. However, the study of such microcontrollers and devices based on them is hampered by the fact that debug boards provided by manufacturers, as a rule, have a very limited number of input and output information and peripheral devices. To organize laboratory work on the study of Atmel AVR microcontrollers, it is proposed to use a laboratory modular layout devoid of these disadvantages.

MAINPART

ИзучениеThe study of microcontroller devices is one of the important disciplines at the university, as this is a field that has recently found wide application in many industries and technical science.

Microcontrollers are used to control complex processes and devices, such as automatic control systems, robotics, information technology, etc.

At the university, students learn both the basics of designing and programming microcontrollers, as well as practical skills in working with them. They acquire knowledge about the hardware of devices, about firmware, programming microcontrollers in C and C ++, and they also learn how to connect devices and read information.

During the training, students work with real-life example projects that include the creation of devices based on microcontroller boards and their programming. Also, during the training, they get acquainted with specialized software tools for software development, with available tools and libraries.

The study of microcontroller devices gives students practical skills in the design of the latest devices and control systems, and also prepares them to work with the most advanced technologies in the modern world. Of course, the study of microcontrollers is the basis for teaching modern electronics and technical science.

When teaching students, an important goal is to study the features of the operation of the hardware of microcontroller systems: the computing core, memory, peripheral devices. It is also important to learn how to properly connect external circuits to the controller, configure it to interact with them, find and analyze errors made during system assembly.

The layout is created using solderless breadboards connected to each other by flexible conductors. On such boards, you can install microcontrollers in output-mounted cases, various devices and modules.

The developed laboratory modular layout layout consists of:

- the main board containing the microcontroller;
- matrix keyboard boards (3x3 buttons);
- boards with a line of LEDs;
- module of seven-segment indicators;
- RGB LED matrix size 8x8;

- an Arduino Uno debug board used as a / SP programmer.

The laboratory layout uses an 8-bit ATmega8 microcontroller with 8 kb of flash memory and 1 kb of RAM.

The Arduino Uno board emulates the avrisp programmer (Atmel AVR/SP) supported by most AVR microcontroller debugging and programming tools.

In accordance with individual tasks for each laboratory work, students assemble a variant of the layout from modules, develop an assembly language program, compile it and enter it into the microcontroller's memory, after which the program will automatically start to run.

The program is typed, edited, assembled and entered into the memory of the MK using the free integrated development environment AVR Studio 4 from Atmel [2]. It can also be used to debug the program.

Currently, in laboratory work on the study of the discipline "Microcontroller devices", using the developed modular layout, work can be performed on the following topics: programming parallel ports, outputting information using LEDs, seven-segment and matrix indicators, programming the processing of external interrupts, entering data into the microcontroller system using the matrix keyboard, programming the timer-counter.

CONCLUSION

The use of a modular training layout for self-assembly in the laboratory work of the Department of Radio Electronics and Telecommunications of the Sevastopol State University for the study of AVR microcontrollers has shown the effectiveness of their use and improves the quality of training of future engineers.

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THE MAIN TYPES OF RADIO JAMMERS

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Аннотация. Статья посвящена рассмотрению типов радио глушителей. В статье даётся определение понятию «радио глушитель». В исследовании рассматривается история создания глушителей. Описывается основная задача радио глушителей. Рассматривается вопрос создания радио глушителей. Приводятся основные типы радио глушителей.

Ключевые слова:радио, глушители, технологии, типы.

Annotation. The article is devoted to the consideration of types of radio jammers. The article defines the concept of "radio jammer". The study examines the history of the creation of silencers. The main task of radio jammers is described. The issue of creating radio jammers is being considered. The main types of radio jammers are given.

Keywords: radio, jammers, technology, types.

Introduction. In general terms, a jammer, which is commonly called a "jammer", is a device that transmits generated radio signals in a certain range of electronic frequencies [1].

Jammers were created with the aim of hindering or completely blocking any electronic devices that use the transmission of information at a certain frequency. At the same time, it must be said right away that the deliberate creation of interference that may impede the operation of communications or broadcast equipment is punishable by law. Therefore, before making or simply using such a device, it is worth carefully considering the possible consequences. But one should consider several main groups of jammers and define the main criteria for circuitry in each of the cases, purely from a scientific point of view [2].



Figure 1 – Types of Radio Jammers

During World War II, ground radio operators would attempt to mislead pilots by false instructions in their own language, in what was more precisely a spoofing attack than jamming. Radar jamming is also important to disrupt use of radar used to guide an enemy's missiles or aircraft. Modern secure communication techniques use such methods as spread spectrum modulation to resist the deleterious effects of jamming [1].

Broadband jammers. The first type is the broadband jammer. It is a device that transmits radio waves generated by it in a wide range of frequencies. This type of jammer has gained the most popularity, but in terms of range, it is also one of the least effective. The problem is that all the power of a broadband jammer is simply "smeared" in too wide a frequency band, and this despite the fact that the device against which it is directed uses a much narrower frequency band. Thus, using a broadband jammer against an eavesdropping bug is like shooting a sparrow with a large-caliber cannon. Of all the power aimed at suppressing the device, only 0.01% hits the target, the rest is simply dissipated, while interfering with all devices in the area of the jammer. Therefore, it is worth using this type of jammer only when the operating range of the spy device is unknown [4].



Figure 2 – Broadband Jammers

As for the circuitry of the broadband jammer, everything is according to the standard. It is a chaotic oscillator (of which there may sometimes be several), which is loaded on a high-power broadband emitter operating at high frequencies. From here, the signal goes to a broadband antenna (of which there may also be several), due to which a very wide range can be covered. By the way, a chaotic oscillator usually works only at certain frequencies. All other frequencies that the generator does not cover can simply be ignored.

Narrow-band jammers. The second type is narrow-band or lowfrequency jammers. Typically, such devices operate simultaneously on only one frequency, and only in rare cases on two, maximum three. They are effective when it is known exactly at what frequency (or narrow band) the device that needs to be jammed transmits a signal. Narrowband jammers can create interference at the required frequency, making it very difficult or completely blocking the operation of the device. Such jammers work especially well against broadband devices, such as televisions. And, by the way, interference does not have to be created at the operating frequency of the device, it is enough if it is even, simply, the neighboring band. Even then, interference will completely drown out the operation of the device. And in order to further enhance the effect, you can modulate the signal generated by the jammer with a signal similar to that through which the jammed device operates. For example, you can create a "comb" focusing on an already known type of signal, and then even if you do not turn on the jammer at high power, all TVs within the range will make noise, howl, yell, but they won't really show anything. The circuitry here is also simple. The generator is simply tuned to the desired frequency, the signal at which is fed to the antenna. True, this is only in general terms, in order to drown out, for example, a mobile phone, you will need a device whose circuitry is somewhat more complicated[3].

Magnetic jammers. The third and last type of jammers are magnetic and low-frequency jammers. True, they cannot be unambiguously attributed to radio jammers, and they have gained much less popularity. As you can tell from the name, this type of jammer has an effect on the node itself, emitting the information that we need to silence. If we imagine it in a simpler form, interference affects the speaker, kinescope, etc. with low-frequency radiation. They are a generator that emits vibrations of sound frequencies approximately within a radius of 10-1000 Hz. Usually their power is several hundred watts, since the efficiency of such a jammer is very low. Typically, the generator is loaded on a special frame, the diameter of which is several centimeters [3]. The frame is placed on the floor or near the ceiling, depending on which direction the radiation should be directed. This same frame emits magnetic waves that affect: speakers; microphones; kinescopes. Forcing them to create unpleasant sounds or severely spoiling the image, due to which the use of the equipment itself becomes impossible. Waves can freely pass through almost any obstacle, making the use of a jammer somewhat simplified. True, as for TVs, only old models with kinescopes can be "dazzled", with new flat panels it is almost impossible to do this. But such jammers are still relevant, as speakers remain highly affected by them.

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UDC 621.3

ROTATING DEVICE FOR MEASUREMENTOF ANTENNA PATTERN

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Аннотация. Разработано поворотное устройство, содержащее шаговый двигатель и управляющий микроконтроллер, которое может быть использовано для измерения диаграмм направленности антенн в дециметровом диапазоне волн.

Ключевые слова: микроконтроллер, программирование микроконтроллера, ротатор, измерение диаграммы направленности антенны.

Annotation. A rotary device has been developed, containing a stepper motor and a control microcontroller, which can be used to measure the radiation patterns of antennas in the decimeter wave range.

Keywords:microcontroller, microcontroller programming, rotator, antenna pattern measurement.

Introduction

Currently, radio engineering systems of the decimeter wave range are widely used using a radio channel for data transmission.

An urgent task is to develop means for measuring the radiation characteristics of antennas for such systems.

The developed device makes it possible to measure the radiation patterns (RP) of decimeter antennas using the rotating antenna method.

Mainpart

The rotator is an extremely important part of the antenna pattern measurement system used in radio engineering and communications. Its task is to accurately determine the angle of rotation of the antenna and the fixed position.

To do this, the rotary device is equipped with a special mechanism that operates on the basis of rotation angle sensors and encoders. They allow you to accurately measure and record the angle of rotation, as well as correct it to achieve the most accurate result.

The use of a rotary device is a necessity in systems for complex monitoring of the quality of radio signals, as well as when testing antennas for various specified parameters. It is also used to rotate antennas in radar detection and targeting systems.

Depending on the design features of the antennas, different types of rotary devices are used. Some are electrical, human controlled, while others may be automatic, software controlled.

It is important to note that the accuracy of measuring and adjusting the angle of rotation of the antenna directly affects its performance and communication quality. Therefore, the use of a quality rotary device is a necessity for achieving optimal results in radio engineering and communications.

The rotary device is part of an automated antenna measuring complex.

Automated antenna measuring complexes are modern technological systems that are used to measure the characteristics of various types of antennas. These complexes are designed to obtain highly accurate and reliable data that can be used to evaluate the quality and efficiency of various types of antenna systems. They are widely used in telecommunications, aerospace and defense industries, etc.

One of the key advantages of using automated antenna measuring systems is their high efficiency and accuracy. These systems use advanced software algorithms and the latest technology to perform accurate measurements and analysis of antenna characteristics. They are able to measure various parameters such as gain, radiation pattern, polarization, impedance and others.

The developed device allows using a personal computer through the USB port to control a stepper motor, which rotates the measured antenna around a vertical axis. This provides automatic measurement of the antenna pattern within the angles of 0° —360°.

The device provides for the use of control keys located directly on the meter itself. This feature allows you to set the desired angle of rotation of the antenna to observe the appropriate signal level. In this case, the value of the angle of rotation of the antenna is displayed on a seven-segment indicator located on the front side of the device.

For accurate positioning of the antenna, a DShG 508 stepper motor [2] with a rotation angle step of 2.8° was used. The angular values of the antenna rotation 0.45° in the step mode of the engine and 0.225° in the half-step mode are achieved using a gearbox with a gear ratio of 6.2. Using the control keys, the zero value of the antenna rotation angle is set. The stepper motor is controlled by the LM298 and LM297 driver chips. In turn, the driver is controlled via a parallel data bus from a microcontroller of the ATMega family [1]. Changing the operating mode of a stepper motor can be done either by changing the corresponding parameter on a personal computer or using the keyboard located on the control panel of the rotary device. When analyzing the signal level from the antenna, the LM358 operational amplifier is used, which amplifies the signal from the signal level sensor. It should be noted that the entire system is powered by a stabilized 220 Vpower supply.

The developed device contains: microcontroller, control panel, control driver, control motor, indicator, personal computer.

CONCLUSION

A device has been developed for use as part of an automated measuring complex for measuring the radiation characteristics of antennas in the decimeter wave range.

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VIRTUAL MACHINE SCHEDULING IN DISTRIBUTED SYSTEMS

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Аннотация. Стратегия управления центром обработки данных требует доступа к достаточным ресурсам для обработки различных запросов приложений при одновременном минимизировании потребления энергии. В отношении высокого изменчивого И потребления ресурсов управление виртуальными машинами (VM) требует динамических стратегий. Динамическое управление VM включает размещение VM и миграцию VM. Представленный в статье подход к управлению направлен на снижение потребления энергии и нарушения уровней обслуживания (SLA) одновременно в центрах обработки данных. Результаты моделирования показывают, что предложенный подход улучшил управление VM на 40% по сравнению с предыдущими подходами, основанными на единственной цели, основанной на потреблении энергии и нарушении SLA.

Ключевые слова: Облачные вычисления, динамическое управление, потребление энергии, нарушение SLA, размещение виртуальных машин.

Annotation. The management strategy of a data center needs access to sufficient resources in order to handle different requests of applications, while minimizing the consumed energy. With regard to high and varying resource demands, Virtual Machines (VM) management necessitates dynamic strategies. Dynamic management of VMs includes VM placement and VM migration. The management approach presented in this paper aimed to reduce the energy consumption and the violation of service level agreements (SLA) simultaneously in data centers. The simulation results indicate that proposed approach improved the VM management 40% compared to the previous single-goal approaches based on the energy consumption and SLA violation rates.

Keywords: Cloud computing, Dynamic management, Energy consumption, SLA violation, Virtual machine placement.

Introduction

In modern computing, client applications are charged for the use of resources from large-scale data centers. Data center managers attempt to reduce energy consumption while providing necessary resources for user applications [8, 10, 20, 22].

Virtualization technology allows for better resource utilization, but may result in access competition between virtual machines during high demand conditions. One should consider the algorithms below that aim to reduce energy consumption by optimizing resource utilization, as well as reducing service level agreement violations [12, 14, 21].

Energy-reduction and SLAV-reduction approaches Algorithm 1. VM placement Process for Energy-Reduction approach

Data: H, VM

H¹,H⁺,H⁻,H^Φ,→ classify (H)
 Sorting of target values H+, H⁻, H^Φ and their combination.
 for h_tCtargets do
 if has_capacity (h_t, VM) then
 place (VM, h_t)
 break
 end

The passage describes the VM Placement policy for the Energy-Reduction approach, which aims to reduce energy consumption in virtualized environments. The policy classifies hosts into different categories based on their utilization and power efficiency, and then sorts them in descending order of efficiency [11, 16, 17]. A list of target hosts is prepared by concatenating the sorted categories, and a First Fit approach is used to assign the VM to the first target host with enough capacity [6, 13]. The focus of the policy is on power efficiency and load distribution across hosts, rather than other considerations. The policy is executed each time a new VM creation request is received.

Algorithm 2.VM Relocation process for Energy-Reduction approach

Data: H

1. Classification of $H^!, H^+, H^-, H^{\varphi}$

2. Sorting the original values of H!.

3. Sorting of target values H+, H⁻, H $^{\phi}$ and their combination.

4: For each value of h in the source data, a check is performed for the possibility of migration to the list of available target values.

5: If you managed to find a free target resource, perform the migration and stop.

Algorithms and policies for transferring virtual machines in the data center for energy consumption and load management are described. Algorithm 2 shows how hosts for virtual machine migration are classified and sorted, as well as how target hosts for migration are selected. The virtual machine migration policy for reducing SLAV differs from the policy for reducing power consumption in the way hosts are sorted [1, 15]. The virtual machine consolidation policy is performed less frequently than the transfer

of virtual machines, and its purpose is to control the load in the data center [9].

Algorithm 3. VM Consolidation process for Energy-Reduction approach

Data: H

1.The input is a set of entities denoted by H, which includes H+, H-, H-, and H φ . The algorithm aims to sort elements and migrate them from sources to targets.

2. The H- set is sorted.

3. Targets are generated by combining the sorted H+ and H- sets.

4-5. Two sets are defined to keep track of used sources and used targets. Both start as empty sets.

6. The loop starts iterating over the sources set, denoted by H-.

7. If the current source has already been used as a target, move on to the next H- entity [15].

8-9. Two nested loops start; the first one iterates over the virtual machines available at the current source, and the second one over the set of available targets [18].

10-11. If the current target has enough capacity to receive the VM from the current source, and it is not the same as the current source or an already used entity, migrate the VM to the target and update the usedSources and usedTargets already migrated or targeted. Stop iterating if a migration occurred, as the loop will begin again with the next element [19].

12-15. If no suitable target is found for the current source, continue with the next source.

Algorithms of virtual machine consolidation policies are described for two approaches: reducing power consumption and reducing SLAV (the probability of exceeding the specified thresholds of response time to a request) [2, 4]. Algorithms classify hosts into loaded, partially used, underused and disabled, then sort them by various criteria, form a list of target hosts and try to free up all hosts in the source lists by transferring their virtual machines to hosts in the target lists using the First Fit heuristic[7]. The approaches use different values of the stresscpu threshold and the mincpu threshold, obtained experimentally and based on the average CPU utilization of hosts [3, p.23].

Algorithm4. Conditions to change the active approach in ESDR

Data: ActiveApproach, per, slav

1: if per < per _{normal} &sla^v<sla^v _{normal} then state \leftarrow Energy

2: if $sla^v >= sla^v_{normal}$ then state $\leftarrow SLAV$

3: if ActiveApproach == Energy_Approach& state == SLAV then Using SLAV_Approach

4: Using SLAV_Approach

5: else if ActiveApproach == SLAV_Approach& state == Energy then
6: Using Energy_Approach
7: end

ESDR is a data center energy management and SLA methodology that achieves two goals at the same time. To do this, ESDR uses two approaches: Energy-Reduction and SLAV-Reduction. Virtual Machine Consolidation Policies are used to manage data center resources, and ESDR switches between these approaches based on data center state changes. ESDR uses SLA violation and power factor efficiency metrics to evaluate whether the proactive approach needs to be changed. Approach switching occurs when the value of the metric associated with the active approach goal is less than the threshold value, while the metric associated with the inactive approach exceeds the threshold value [5].

Table 2 shows the default values of the ESDR parameters that were obtained after 12 iterations of the experiments.

Parameter	Normal Value	Description		Calculation method	Calculation method		
per _{normal}	71.817	Normal value fo	r power efficiency threshold	The average value of Energy-Reduction an	The average value of energy efficiency in both Energy-Reduction and SLAV-Reduction approaches		
sla ^v normal	1.644	Normal value for	r SLA violations threshold	The average value of Reduction and SLAV-	The average value of SLA violation in both Energy- Reduction and SLAV-Reduction approaches		
Interval Running Approach	1 h	Time interval for	r running ESDR approach	-			
	1.2 1 0.8 0.6 0.4 0.2 0	SLAV- Reduction	Energy- Reduction	ESDR			
	= Score	1	1	0.599			

Table 2 Default values of ESDR's parameters

Conclusion

The strategies provided in the study successfully manage two primary objectives of dynamic data center management: enhancing power efficiency and minimizing SLA violations, acknowledging the built-in trade-off between these objectives.

Managing conflicting goals simultaneously in data centers can be challenging, and making an efficient comparison based on various metrics is cumbersome. The study's authors propose three approaches: EnergyReduction and SLAV-Reduction, as single-goal approaches, and ESDR, a dual-goal approach that balances energy consumption and SLA violations.

Experimented under the same conditions, the results demonstrate ESDR's superior performance in managing these goals, improving scores by 40% compared to individual-goal approaches.

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COMPARATIVE ANALYSIS OF MSP AND MAVLINK UAV CONTROL AND TELEMETRY PROTOCOLS

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 3rd year student, Electronicsengineering Department, Sevastopol State University, e-mail: popova030321@gmail.com Аннотация. В данной статье проводится сравнительный анализ двух протоколов управления и телеметрии беспилотных летательных аппаратов - MSP и MAVLink. В статье рассматриваются особенности каждого протокола, включая их структуру, основные функции, возможности передачи данных, а также преимущества и недостатки. Анализируются, какой протокол более подходит для различных проектов в зависимости от требований к БПЛА, аппаратной и программной части, условий эксплуатации и других факторов.

Ключевые слова: MSP, MAVLink, БПЛА, управление, телеметрия, протокол связи, передача данных, программная часть, аппаратная часть

Annotation. This article provides a comparative analysis of two protocols for controlling and transmitting telemetry data for unmanned aerial vehicles (UAVs) - MSP and MAVLink. The article discusses the features of each protocol, including their structure, main functions, data transmission capabilities, as well as advantages and disadvantages. The article analyzes which protocol is more suitable for different projects depending on the requirements for UAVs, hardware and software components, operating conditions, and other factors.

Keywords:MSP, MAVLink, UAV, control, telemetry, communication protocol, data transfer, software part, hardware part

1. Introduction

In recent years, unmanned aerial vehicles (UAVs), also known as drones, have gained widespread use in various fields including aerial photography, agriculture, natural resource monitoring, and more. UAVs are controlled and monitored using management and telemetry protocols. This article will conduct a comparative analysis of two of the most popular protocols: MSP and MAVLink. The features, advantages, and disadvantages of each protocol will be examined, as well as a comparative analysis based on real-world tests. The results of this research can be useful for UAV developers and software engineers, as well as end-users who utilize UAVs in their work. The article will also examine the possibilities and limitations of each protocol, as well as recommendations for protocol selection depending on specific tasks. The conclusions drawn from the research will provide insight into which protocol is more preferable for a given situation, as well as what additional features and improvements can be realized when using these protocols. Overall, this article represents a valuable contribution to the research and development of UAV technologies and their management and telemetry protocols.

2. Problem statement

The problem that this article addresses is the selection of the most optimal control and telemetry protocol for UAVs. With the widespread use of UAVs in various fields, choosing the right protocol becomes critically important as it affects the performance and efficiency of UAVs in performing various tasks. There are numerous control and telemetry protocols available, and choosing the most suitable one can be challenging. The aim of this article is to compare two of the most common control and telemetry protocols, MSP and MAVLink, and provide readers with the necessary information to choose the most suitable protocol for a particular task. Therefore, the article will be useful for UAV developers, software developers for UAVs, as well as endusers who use UAVs in their work. Additionally, an important aspect addressed by this article is the analysis of the features of each protocol, their advantages, and disadvantages.

This will provide a deeper understanding of how each protocol interacts with UAVs and how it can affect the performance and stability of UAVs. The article will also address the question of the capabilities and limitations of each protocol, which will help readers better understand what functions and capabilities are available when using one or the other protocol.

3. Comparative analysis of MSP and MAVLink

MSP (Multiwii Serial Protocol) is a protocol used to control and obtain telemetry information from unmanned aerial vehicles (UAVs) [3]. It was developed by the Multiwii community to provide a simple and efficient communication link between the autopilot and ground station.

The MSP protocol consists of a sequence of bytes that are transmitted between the autopilot and ground station via a serial port (UART). It uses a binary data transmission format, which makes it more efficient compared to text protocols such as ASCII.

MSP has various commands and options that allow controlling and configuring different aspects of UAV operation. For example, the MSP_SET_RAW_RC command can be used to set values for each of the control channels, and the MSP_SET_PID command can be used to adjust PID controller parameters.

The MSP protocol has several advantages, such as simplicity and reliability. It also has a low latency and a small amount of transmitted data, making it suitable for use on low-power microcontrollers.

However, MSP also has some disadvantages. For example, it does not have built-in support for working with a graphical user interface, such as Mission Planner or QGroundControl. It also does not have an open and extensible message format, which can make it difficult to develop custom solutions based on it.

				MSPv1 checksummable data	
MSP magic \$M si	MSP Virection/ tatus flag	MSPv1 payload size	MSPv1 frame ID	MSPv1 payload (254 bytes max)	MSPv1 checksum

Pic. 1 – MSPframe

MAVLink (Micro Air Vehicle Link) is a communication protocol designed for unmanned aerial vehicles and other robotics systems[2]. MAVLink is developed as an open standard that allows different systems to exchange information, such as control commands, telemetry data, system state, and more.

MAVLink operates on a "master-slave" principle, where the system that sends control commands or requests data is the master, and the system that receives commands or sends data is the slave. Control commands and telemetry data are transmitted as messages that contain information about the message type, length, and content. Any type of communication channel can be used as the physical communication channel, including wireless, wired, or serial channels.

MAVLink provides a wide range of messages that allow various types of information to be transmitted, such as coordinates, speed, altitude, sensor state, and more. In addition, MAVLink has a number of features that facilitate working with the protocol, such as message integrity checking and automatic generation of API interfaces for different programming languages.

MAVLink is a popular protocol in the unmanned aerial vehicle and robotics community in general. It is used in various projects and systems, including the ArduPilot project and the PX4 library [1].





Pic. 2 – MAV linkframe

MSP was developed for use with multirotor UAVs and is used in control systems such as MultiWii, Baseflight, and Cleanflight. It provides a simple and fast way to communicate between the flight controller and the ground control application. MSP uses an asynchronous serial port for data transmission and supports various commands for reading and writing parameters on the flight controller.

On the other hand, Mavlink was developed for use in various types of UAVs and supports multiple programming languages. It uses an open data transmission format, which allows for the use of various types of data
transmission, including Wi-Fi and Bluetooth. Mavlink also supports multiple commands that can be used to control the UAV and obtain telemetry.

Overall, Mavlink offers more programming and device connectivity options, while MSP provides a simpler and faster way to control multirotor UAVs. The choice between these two protocols depends on specific needs and tasks for which the UAV is being used.

4. Conclusion

In conclusion, it can be said that MSP and MAVLink protocols have their own advantages and disadvantages, and the choice between them depends on the specific requirements of the project. MSP is simpler to use and understand, but its functionality is limited and may not be suitable for more complex projects. MAVLink, on the other hand, has more functionality and flexibility, but may be more complex to use and require more time for setup.

Overall, when choosing a protocol for controlling UAVs and receiving telemetry information, it is necessary to take into account the specific requirements of the project and evaluate which of the protocols is better suited to solve the tasks.

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NEURAL NETWORKS IN THE FIELD OF SIMPLIFICATION OF ELECTRONIC DOCUMENT MANAGEMENT

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4th year student, Institute of Radio Electronics and Intelligent Technical Systems, Sevastopol State University, e-mail: mihalich168@mail.ru Danila Ageev 4th year student, Institute of Radio Electronics and Intelligent Technical Systems, Sevastopol State University, e-mail:super.danil232@ya.ru Dmitry Tabakaev Scientific advisor, senior lecturer, Institute of Radio Electronics and Intelligent Technical Systems, SevastopolStateUniversity Аннотация. Быстрое развитие информационных технологий и их реализация во всех сферах жизни привели к тому, что сегодня невозможно представить даже маленькую вещь, которая не была бы оснащена информационной технологией. В то же время растет потребность в разработке новых интеллектуальных систем для поддержки управленческих решений и адаптации их к самому широкому спектру возможных условий. Наиболее перспективным направлением здесь является использование нейронных сетей. В данном исследовании представлены возможности нейросетей в упрощении работы с документами.

Ключевые слова: нейросети; документы; отчётность; автоматизация; документооборот.

Annotation. The rapid development of information technologies and their implementation in all spheres of life has led to the fact that today it is impossible to imagine even a small thing that would not be equipped with information technology. At the same time, there is a growing need to develop new intelligent systems to support management decisions and adapt them to the widest range of possible conditions. The most promising direction here is the use of neural networks. This study presents the possibilities of neural networks in simplifying work with documents.

Keywords: neural networks; documents; reporting; automation; document flow.

An artificial neural network (ANN) is a mathematical model that has a software or hardware implementation. The name came from a comparison with the principle of operation of biological neural networks. Neural networks are not programmed in the usual sense of the word, they are trained. The possibility of learning is one of the main advantages of neural networks over traditional algorithms, since neural networks allow you to predict several quantities at once (and even simultaneously solve classification and forecasting problems) with one model. At the same time, neural networks require significantly more resources — both hardware and prepared data necessary for training.

The development of neural networks is connected both with the development of technologies and with the contribution of the global IT community to the training of various models on a large number of different data sets.

Perhaps the most popular application of neural networks today is the recognition of visual images, audio and video. Neural networks significantly facilitate human labor and save businesses millions of man-hours per year.

The unified formats of documents approved by the state have remained in history. Now each organization has the right to develop its own document template. With the advent of this rule, the variety of incoming documents surprises even sophisticated specialists. At the same time, there is a problem of their analysis and the establishment of system documents in the program based on them.

The solution to this problem is paper and electronic document recognition systems. The software for such analysis will be based on neural networks that are trained on templates of many primary documents.

Developers of recognition programs will be able to "explain" the program by machine analyzing millions of different documents:

1. What are the criteria for a properly executed document?

2. What data should be "taken" from the scanned document to be carried out in the ERP program?

3. What documents should be rejected by the counterparty for revision?

At the current stage of development, text recognition software systems are able to identify the main sections of the document ("header", basic data, signatures). With a sufficient number of documents for "training", neural networks are able to begin to evaluate where the number, date, list and other information is indicated in the document.

Recognition of individual values will significantly speed up the document processing process, because specialists will not have to manually fill in fields in system documents. With a high-quality image, they will be filled with a neural network.

Neural networks in document recognition programs will independently determine the author, date, document number, name, quantitative characteristics, etc. The system document will be filled in automatically.

Automated document management does not completely exclude errors (typos in the document itself, a new data format, new types of documents), but it reduces the amount of work of a specialist and, as a result, increases the efficiency of his work. Each line in the accounting program will only need to be checked against the primary document.

Of course, document recognition systems will not be a salvation from all problems with documentation. They will not force a person to send the necessary documents in time, but they will greatly simplify the workflow. But this kind of neural networks will help accountants optimize their work.

Automation of routine tasks

Working with documents consists not only of processing incoming documents, but also additional operations necessary for correct reporting. The most striking example is the "closing" of the period, which includes a whole list of business operations.

The personal list of operations for "closing" the period may change. Neural networks are perfect for reducing labor costs, speeding up the processes of performing routine operations and eliminating errors. They can perform operations at night, they are able to check millions of transactions, they do not go on vacation. With proper configuration of the "closing" algorithms and description of all critical errors, the program will be able to independently perform all the necessary steps and present the results of the work to the specialist.

The transition to document management using neural networks will greatly simplify the processes of "closing" and increase the speed of providing data to determine the result. If you lay down the sequence of documents being carried out, a list of control points and the required final result, the neural network will be able to calculate and distribute the costs of producing a variety of items by itself.

In more advanced cases, you can automate the process of checking reports. Primary documents digitized using recognition systems can be checked for critical errors. The neural network will be able to assess the risk of error for each document, and when integrated with external control services, the assessment will be as accurate as possible.

The key problem of such functions is the amount of data for training. For a high-precision risk assessment, information about a variety of inspections is needed. Small and medium-sized businesses rarely have such information. At the same time, a large business that has many legal entities will have enough materials for training neural networks.

Document flow control

Control is a vital stage of any activity. Errors in numbers, typos in documents and other comments can lead to grandiose consequences. At the same time, labor costs for checking primary documents, various kinds of reporting and other business operations take a long time.

Neural networks come to the rescue: by including all the mandatory control ratios in the algorithm, the program will independently check them and report errors. Similar functionality already exists in specialized reporting programs and in most accounting ERP systems. However, the development of neural networks will expand the possibilities for finding errors.

In machine analysis, it will be possible to include not only the reconciliation of fields in reports, but also more complex checks. The versatility of neural networks helps to digitize any controls. You will only need a formalized description of the checks that are currently being performed manually, and a sufficient amount of data to train the neural network.

It is important to understand: the inclusion of neural networks in the processes of checking operations does not negate the need for human control over these processes and the creation of secondary documents based on the processing of primary ones. Machine learning cannot replace professional judgment and optimization experience. Such tools should be considered as an additional opportunity to speed up processes and reduce the number of errors.

There are a number of tasks related to classification, prediction and recognition in which neural networks have no equal. Decades of research and significant development of technologies and hardware have accelerated machine learning and created new technologies for effective image processing — for example, convolutional networks.

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RESEARCH OF COVID-19 IDENTIFICATION METHODS ON LUNG CT USING NEURAL NETWORKS

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Аннотация. В статье рассмотрены методы классификации и семантической сегментации, применяемые на срезах КТ легких для COVID-19. Сравниваются автоматизации диагностики архитектурыCNN иCapsNet, классификации используемые для изображений, а также архитектурыDeepLab иU-net, применяемые для результате лучшие сегментации. В модели, основанные на рассматриваемых метолах достигают точности 90.8% на валидационных данных в задаче классификации срезов на наличие COVID-19.

Ключевые слова: Капсульные нейронные сети, сверточные нейронные сети, COVID-19, компьютерная томография, полностью автоматизированная классификация, глубокое обучение, искусственный интеллект.

Annotation. The paper discusses the methods of classification and semantic segmentation used on CT lung slices to automate the diagnosis of COVID-19. The CNN and CapsNet architectures used for image classification are compared, as well as the DeepLab and U-net architectures used for segmentation. As a result, the best models based on the methods under consideration achieve an accuracy of 90.8% on validation data in the task of classifying slices for the presence of COVID-19.

Keywords: Capsule neural networks, convolutional neural network, COVID-19, computed tomography, fully automated classification, deep learning, artificial intelligence.

Introduction

The recent outbreak of the novel coronavirus infection (COVID-19) has sparked an unforeseeable global crisis since its emergence in late 2019. The rapid spread of the disease has caused a great strain on the health care system of countries around the world. This arises the need to distinguish normal cases and non-COVID infections from COVID-19 cases in a timely fashion to put a higher focus on COVID-19 infected cases. Using deep learning-based algorithms to classify patients into COVID and non-COVID, health care professionals can exclude non-COVID cases quickly and allow for paying more attention and allocating more medical resources to COVID-19 identified cases. It is proposed to use neural networks to preserve spatial relationships and increase classification accuracy. In addition, it is necessary to use pre-segmentation of individual CT slices to separate the lungs from the rest of the thorax. In the following, the current methods and algorithms used for image classification and segmentation in application to this problem will be considered.

Deep learning image classification methods

1. Convolutional neural network

A Convolutional Neural Network (CNN) is a type of artificial neural network that is primarily used for image classification, object recognition, and computer vision tasks. The basic operation of a CNN model involves several layers of processing, which are typically organized as follows.

1. Convolutional Layer: This layer applies a set of learnable filters to the input image to produce a set of feature maps. Each filter extracts a different set of features from the input image, such as edges, corners, and blobs.

2. Pooling Layer: This layer reduces the size of the feature maps by performing a down-sampling operation, typically by taking the maximum or average value of each local region.

3. Activation Layer: This layer applies a non-linear activation function to the output of the pooling layer, such as ReLU (Rectified Linear Unit), which introduces non-linearity into the model and enables it to learn complex features.

4. Fully-Connected Layer: This layer connects all the neurons in the previous layer to the output neurons, which are responsible for generating the final output, such as a classification label or a regression value.

The formal algorithm for convolution can be represented mathematically as:

 $O(i,j) = \sum \left(\sum (I(x,y) * F(i - x + K/2, j - y + K/2)) \right).$

Where O is the output image, I is the input image, F is the filter/kernel, K is the kernel size, and i, j, x, and y are the indices of the pixels in the output and input images, respectively.

CNNs have demonstrated exceptional performance in image classification tasks, outperforming traditional machine learning methods by a significant margin. For instance, in the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) 2012, AlexNet, a CNN architecture, achieved a top-5 error rate of 15.3%, which was a significant improvement over the previous state-of-the-art method [2]. Since then, several CNN architectures have been proposed, achieving even better accuracy. For example, ResNet-152 achieved a top-5 error rate of 3.57% on the ILSVRC 2015 dataset [8].

2. Capsule neural network

Capsule neural networks (CapsNets) are a type of neural network that have been proposed as an alternative to traditional convolutional neural networks (CNNs). CapsNets were first introduced by Hinton et al. In 2017 and are based on the idea of using "capsules" - groups of neurons that work together to detect specific features in an input image or sequence. A capsule neural network operation formal algorithm [10].

1. Initialize the input layer with the input data: $u_i^{(0)} = x_i$.

2. Apply a set of convolutional filters to the input layer: $s_i^{(1)} =$ $\sum_{i} W_{i,j}^{(1)} u_{i}^{(0)} + b_{j}^{(1)}$.

3. Convert the output of the convolutional filters into capsules: $v_i^{(1)} =$ $\frac{\left|s_{j}^{(1)}\right|^{2}}{1+\left|s_{i}^{(1)}\right|^{2}}\frac{s_{j}^{(1)}}{\left|s_{j}^{(1)}\right|}$

4. Compute the activation level of each capsule: $a_i^{(1)} = \sum_i v_i^{(1)} W_{i,i}^{(2)}$.

5. Apply the non-linear squashing function: $v_j^{(2)} = \frac{|a_j^{(1)}|^2}{1+|a_i^{(1)}|^2} \frac{a_j^{(1)}}{|a_j^{(1)}|}$.

6. Use the output of the capsules as input to the next layer of capsules: $u_j^{(2)} = v_j^{(2)}$.

7. Compute the agreement between each capsule in the current layer and each capsule in the previous layer.

8. Update the weight matrix associated with each capsule in the current layer using the agreement: $W_{i,j}^{(3)} \leftarrow W_{i,j}^{(3)} + \alpha c_{i,j} v_j^{(2)}$.

9. Repeat steps 5-8 for each subsequent layer of capsules until the output layer is reached.

One of the main advantages of CapsNets is their ability to model hierarchical relationships between features. Capsules in one layer of the network can predict the presence and properties of capsules in the next layer, allowing the network to build up a hierarchical representation of the input.

Some specific results achieved using CapsNets include a 0.25% error rate on the MNIST dataset, compared to a 0.35% error rate achieved by a CNN baseline (Hinton et al., 2017) [10], 6.86% error rate on the CIFAR-10 dataset, compared to a 7.42% error rate achieved by a CNN baseline (Edgar Xi, 2017) [6]. A 2018 research by Zhao et al.[11] showed that CapsNets improved the accuracy of capsule networks to 98% on the CIFAR-10 dataset, which are competitive with the state-of-the-art results obtained using CNNs.

In addition, CapsNets has been used in more recent studies to improve the performance of capsule networks in various tasks such as object recognition and segmentation, medical image analysis, and speech recognition. For example, in a 2020 research by Cai et al.[3], CapsNets was used to improve the accuracy of capsule networks to 96% in detecting lung nodules on CT scans.

Overall, CapsNets is a promising approach for improving the performance of capsule neural networks, and it has demonstrated significant advances in various image classification tasks compared to CNN.

Semantic segmentation methods

1. DeepLab neural network model

DeepLab is a convolutional neural network (CNN) architecture designed by Google researchers for semantic image segmentation, which is the process of dividing an image into multiple segments and assigning each pixel to a specific object category.

DeepLabv1 uses a modified VGG-16 network with atrous convolutions in the last two convolutional layers to generate a coarse segmentation map. The model then applies a CRF to refine the segmentation and produce the final result. DeepLabv2 improves upon this by using atrous spatial pyramid pooling (ASPP), which employs parallel atrous convolutions at multiple scales, to capture context information at different resolutions. This helps the model to better handle object boundaries and small objects. DeepLabv3 adds the use of batch normalization and residual connections to further improve performance, while DeepLabv3+ introduces a decoder module that upsamples the features and combines them with low-level features to produce more accurate segmentation results.

A formal Atrous Spatial Pyramid Pooling (ASPP) algorithm.

Input: a feature map *F* of size HxWxC, where *H* and *W* are the height and width of the map, respectively, and C is the number of channels. A set of atrous rates R = r1, r2, ..., rn, where ri is the dilation rate of the i-th convolution.

1. For each atrous rate ri in R:

 \circ apply a 3x3 convolution with dilation rate ri to F, producing a feature map *Fi*;

o apply batch normalization and ReLU activation to Fi.

2. Concatenate the feature maps along the channel dimension, producing a feature map G.

3. Apply a 1x1 convolution to G to reduce the number of channels to C, producing a feature map H.

DeepLab has been extensively evaluated on various datasets and tasks, including PASCAL VOC, COCO, Cityscapes, and ADE20K. On the PASCAL VOC 2012 dataset, DeepLabv3+ achieves a mean intersection over union (mIoU) of 89.0%, which is good result [4]. On the COCO dataset, DeepLabv3+ achieves an mIoU of 51.7% on the validation set, which is also good result [7]. Moreover, DeepLab has been applied to various real-world applications, such as autonomous driving, medical image analysis, and satellite imagery analysis.

2. U-net neural network model

U-Net is a convolutional neural network architecture that is commonly used for image segmentation tasks, particularly in the medical domain. It was first proposed by Ronneberger et al. In 2015 [9] and has since become a popular choice for various segmentation tasks. A formal U-net operation algorithm.

Inputs: input image X, desired output Y, number of layers and channels, activation function, learning rate, number of epochs.

Initialize input image X and desired output Y.

For each epoch i:

perform forward propagation through E layers: Zi = A(Ei(Zi-1));

pass the output of the encoder through decoder layers: Z'i = Di(Zi);

concatenate the output of the decoder with the corresponding encoder output: $Z''_i = \text{concat}(Z'_i, \text{Zn-}i+1);$

perform another convolutional layer with a smaller kernel size: Z^{"'}i = A(conv(Z^{"i}, Wi, bi));

repeat steps c and d until the final output is obtained: $\hat{Y} = Z$ "e;

calculate the loss between the output and desired output: $J = L(Y, \hat{Y})$; backpropagate the error and update the weights and biases using

gradient descent:

 $W_i = W_i - \alpha * \partial J / \partial W_i, b_i = b_i - \alpha * \partial J / \partial b_i.$

Repeat step 2 for e epochs.

Evaluate the trained network on a test dataset.

U-Net has achieved state-of-the-art results in various medical image segmentation tasks, including segmenting brain tumors from MRI scans, identifying lung regions from CT scans, and detecting nuclei in histology images. In recent research, U-Net has been applied to segmenting the optic disc and cup from retinal fundus images, and segmenting COVID-19 infected regions from CT scans [5]. Another study by Chen et al. (2018) compared the performance of several neural network architectures, including U-Net, on the PASCAL VOC 2012 dataset [4]. The U-Net architecture achieved an IoU score of 90%, which was higher than the other architectures tested, including DeepLab.

One of the notable advantages of U-Net is its ability to handle a small amount of training data. This has been demonstrated in a study by Ronneberger et al. (2015), where the authors showed that U-Net outperformed other state-of-the-art (IoU 0.9) segmentation methods when trained on a small dataset[9]. One of the advantages of DeepLab is its ability to handle large images with high resolution. This has been demonstrated in a study by Chen et al. (2018) [4].

In terms of performance, both UNet and DeepLab have shown promising results in various applications. However, the choice of architecture depends on the specific task and the available data. U-Net is a good choice for tasks involving a small amount of training data, which is better suited for the task of segmenting lung images on CT slices. In this case, high resolution is not required, but the open datasets are small so that they can be used with DeepLab.

Conclusion

As a result, the considered methods can be applied and solve the complex problem of classification of COVID-19 signs on CT of lungs. Semantic segmentation is used to cut off the lung region from the rest of the chest and improve overall accuracy. During the comparison of popular models, CapsNet showed better efficiency over CNN, and Unet also showed better results that surpass DeepLab in the segmentation task.

In a recent study, a simulation of an open-source COVID-CT-MD dataset [1] showed a CNN classification accuracy of 90.8%, a sensitivity of 92.7%, and a specificity of 88.3%. Meanwhile, other solutions based on a simple CNN show lower accuracy and the need to use large amounts of data for training, which is a challenge in the case of medical data on new diseases. Therefore, it is proposed to use capsule neural networks as applied to CT lung imaging for COVID-19 classification.

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UDC 621

WORDPRESS PLUGINS AS A CHVVMU.RU SITE SECURITY TOOL

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Аннотация. Всем известно, что Интернет – это глобальная получить всемирная сеть, гле человек может необходимую информацию. Собственный сайт позволяет всем желающим получить максимум информации о перечне услуг или продукции. Структура сайта должна быть простой, эстетичной и удобной. Кроме того, важна безопасность веб-ресурса. К сожалению, киберпреступники ежедневно тысячи веб-сайтов. Злоумышленники используют взламывают взломанные сайты для самых разных задач, от создания фишинговых страниц до рассылки SEO-спама. Мотивы взлома сайта столь же разнообразны, как и методы, используемые для этих целей. Из этого следует, что практически любой веб-сайт может стать мишенью киберпреступников.

В статье рассматриваются функциональные возможности CMS Wordpress. Популярность этой системы управления сайтом заключается в бесплатном открытом исходном коде и наличии множества плагинов.

Проведен анализ мер защиты сайта chvvmu.ru от различных атак с использованием плагинов безопасности. Повторный пентест сайта информационной факультета радиотехники безопасности И Нахимовского Черноморского высшего военно-морского училища chvvmu.ru позволяет проанализировать уязвимости, способные нарушить работу системы, и вовремя предотвратить угрозы. В статье описаны способы защиты нашего сайта на CMS Wordpress, такие как изменение прав доступа к конфигурационным файлам и каталогам, настройка двухфакторной аутентификации. Анализ эффективности плагинов: Wordfence Security для проверки всех файлов на сайте на наличие вредоносного кода, бэкдоров. Он регулярно сканирует вашу установку на наличие вредоносного кода и имеет брандмауэр в реальном времени, который поможет защитить ваш сайт от известных (и неизвестных) угроз. Расширенные функции, такие как блокировка IPадресов и защита от грубой силы входа в систему, позволяют владельцам сайтов быть спокойными. Премиум-версия включает в себя блокировку по странам, двухфакторную аутентификацию, а брандмауэр обновляется в режиме реального времени.

Akismet Anti-Spam проверяет все ваши комментарии по нашей постоянно растущей глобальной базе данных спама, чтобы удалить нерелевантный вредоносный контент до того, как он будет опубликован и подорвет доверие к вашему сайту. Очевидно, что для правильной работы веб-ресурса необходимо следить за его безопасностью, которую можно обеспечить с помощью плагинов.

Ключевые слова: Сайт, CMS (Система управления контентом), Плагин, DDoS атака - вид вредоносного воздействия на сайт.

Annotation. Everyone knows that the Internet is a global worldwide network where a person can get the necessary information. Our own website allows everyone interested to get maximum information about the list of services or products. The structure of the site should be simple, aesthetic, and convenient. In addition, the security of the web resource is important. Unfortunately, cybercriminals hack thousands of websites every day. Attackers use hacked sites for a wide range of tasks, from creating phishing pages to sending SEO spam. The motives for hacking a website are as diverse as the methods used for such purposes. It follows from this that almost any website can become the target of cybercriminals.

The article discusses the functionality of CMS Wordpress. The popularity of this site management system lies in the free, open source code and the availability of a variety of plugins.

The analysis of site protection measures is carried out chvvmu.ru from various attacks using security plugins. Repeated pentest of the website of the Faculty of Radio Engineering and Information Security of Nakhimov Black Sea Higher Naval School chvvmu.ru allows you to analyze vulnerabilities that can disrupt the system and prevent threats in time. The article describes ways to protect our site on the Wordpress CMS, such as changing access rights to configuration files and directories, setting up two-factor authentication. The analysis of the effectiveness of plugins: Wordfence Security to check all files on the website for the presence of malicious code, backdoors. It regularly scans your installation for malicious code and has a real-time firewall that will help protect your site from known (and unknown) threats. Advanced features, such as blocking IP addresses and protection against brute force logins, allow site owners to be calm. The premium version includes country-by-country blocking, two-factor authentication, and the firewall is updated in real time.

Akismet Anti-Spam checks all your comments against our constantlygrowing global spam database to remove irrelevant, malicious content before it gets published and hurts your site's credibility.Obviously, aor the proper operation of a web resource, it is necessary to monitor its security, which can be provided with plugins.

Keywords: Website, CMS (Content Management System), Plugin, Hacking of the site, DDoS attack (Denial of Service).

Introduction

Web sites have become an integral part in all spheres of human life, because they enable everyone interested to get maximum information about the list of services or products. A high-quality website should be informative, aesthetic, have a normal speed of opening a resource, and most importantly, invulnerable to hacking attempts using common methods. A secure site requires vigilance when developing a web application, configuring a web server, and when writing password creation and update policies [1].

The article analyzes the security of the website of the Faculty of Radio Engineering and Information Security of Nakhimov Black Sea Higher Naval School chvvmu.ru created on the Wordpress platform. The choice of this CMS is obvious, there is a prospect of using unlimited possibilities, flexible customization of appearance and functionality, ease of administration, and it is also free. According to data in 2022 provided by W3Techs, WordPress is the most popular CMS, and 64.2% of all sites that use content management systems work on it (fig. 1) (https://timeweb.com/ru/community/articles/w3techs-v-2022-godu-43saytov-v-mire-rabotayut-na-wordpress).



Fig. 1 – The popularity of CMS sites

With the growing popularity of using Wordpress, the risk of attacks on websites increases. According to statistics, hackers attack sites on this engine about 90,000 times per minute. Attackers hack websites for a wide range of tasks, for example, to send spam, install malicious software, infect users' computers, steal personal data and gain access to a hosting server. As a result, it is necessary to take responsibility for the safety of the information project [2].

Due to political events, namely the beginning of a special military operation on February 24, 2022, the number of attacks on the websites of the Russian Federation and, in particular, on the website of the Faculty of Radio Engineering and Information Security of the Nakhimov Black Sea Higher Naval School chvvmu.ru increased. In order to protect the site from a wide range of malicious threats, such as malware, hacker attacks, DDOS and brute force attacks (brute force attacks), plugins are installed.

The Wordfence Security plugin is equipped with multifunctional features that ensure the security of the site from hacking attempts. And in case of malware infection, Wordfence will search for infected files. The firewall analyzes all visitor traffic just before it reaches the WordPress site. If intruders are detected among the traffic, the plugin blocks them before they can get to the site and cause any harm [3].

Malicious login attempts were by far the most common attack vector targeting WordPress sites. These attempts included credential attacks using lists of stolen credentials, dictionary attacks, and traditional brute force attacks (table 1).

Block Type	Complex	Brute Force	Total
today	22	0	12
week	66	0	66
month	171	0	171

Table 1 –Number of firewall attacks blocked

The installed Login user Dashboard plugin analyzes attempts to hack the site by selecting login data. This attack is based on various methods of password selection. Brute force attacks on the site can continue indefinitely until the bot detects a combination of username and password that will allow an attacker to enter the server side of the site, or the bot will run out of passwords to verify [4]. This type of attack was not possible on the site chvvmu.ru, since the following security measures have been observed:

- a strong username and password have been used;
- limited number of login attempts;
- two-factor authentication is enabled.

The security of chvvmu.ru site on CMS WordPress is an important aspect for high—quality training of students of Nakhimov Black Sea Higher Naval School. For the effective functioning of the service, it is necessary to provide protection against malware, spam, database loss, administrator and user data leaks and various methods of violating the reliability of a web resource. A secure site must remain operational in case of a cyberattack and be virtually invulnerable to hacking attempts using common methods [5].

One of the methods to protect the site is to have proper file access rights. Having the correct file access rights is important for the security and functioning of the site. One of the methods of site protection is to have proper access rights to files and directories. The access rights that are installed on files and folders belonging to the WordPress content management system have a very serious impact on the security of the site. If you distribute the wrong rights, then you can expect a variety of errors in the functioning of the site, whether it is a white screen of death instead of a page, or the inability to upload images to a multimedia folder. Moreover, incorrectly set access rights can destroy the entire security system of the site, making it extremely vulnerable to attacks by intruders (fig. 1).

e Permissions			
	Relative Path	Suggested	Actual
/		0755	0700
/wp-admin		0755	0755
/wp-includes		0755	0755
/wp-config.php		0444	0644
/wp-content		0755	0755
/wp-content/themes		0755	0755
/wp-content/plugins		0755	0755
.htaccess		0444	0644

Fig. 2 - Access rights to WordPress configuration files

Two-factor authorization is configured to protect the site from hacking. For additional user identification via e-mail, using the Login user Security plugin on the PMU website, when registering, the user receives a verification code and logs in using two-factor authentication [6].

For the normal functioning of the site, it is necessary to protect it from spam, as this can lead to infection with viruses, brute force or DDoS attacks. On the website chvvmu.ru the Akismet AntiSpam plugin is installed. This plugin is one of the best for spam protection. The functionality includes: automatic checking of all comments, viewing spam in comments [7].

Conclusions

The popularity and openness of the WordPress CMS architecture have made it very vulnerable and accessible to intruders who can harm the resource, so none of the methods and plugins described above guarantees 100% protection of the WordPress site from hacking. In order to work correctly and reduce the risks of hacking a web resource, it is necessary to apply preventive measures, analyze the information environment and comply with the protection measures of the WordPress site.

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 Защитите свой сайт WordPress бесплатно с помощью Wordfence

 Security
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RESEARCH ON THE USE OF CONVOLUTION NEURAL NETWORKS FOR THE PROBLEM OF IMAGE SEGMENTATION

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Аннотация. Сверточные нейронные сети (CNN) стали мощным инструментом для решения различных задач компьютерного зрения, включая классификацию изображений, обнаружение объектов и сегментацию. В этой статье мы представляем обзор фундаментальных концепций, лежащих в основе CNN, включая функции свертки, объединения и активации. Мы также обсудим популярные архитектуры CNN, такие как AlexNet, VGGNet, ResNet и InceptionNet, и их приложения. Кроме того, мы углубимся в применение CNN для задач сегментации изображений, включая архитектуры U-Net и SegNet. В целом, эта статья призвана предоставить всестороннее введение в область CNN как для исследователей, так и для практиков.

Ключевые слова: сегментация, компьютерное зрение, нейронная сеть, свёрточная нейронная сеть, свёртка.

Annotation. Convolutional Neural Networks (CNNs) have emerged as a powerful tool for various computer vision tasks, including image classification, object detection, and segmentation. In this article, we provide an overview of the fundamental concepts behind CNNs, including convolution, pooling, and activation functions. We also discuss popular CNN architectures, such as AlexNet, VGGNet, ResNet, and InceptionNet, and their applications. Additionally, we delve into the application of CNNs to image segmentation tasks, including the U-Net and SegNet architectures. Overall, this article aims to provide a comprehensive introduction to the field of CNNs for researchers and practitioners alike.

Keywords: segmentation, computer vision, neural network, convolution neural networks, convolution

1. STATEMENT OF THE SEGMENTATION PROBLEM

What is computer vision? Computer vision is a field of study that focuses on enabling computers to interpret and understand digital images and videos from the world around them. It involves the development of algorithms and techniques to analyze and extract meaningful information from visual data [1]. Computer vision has a wide range of applications, including object recognition, face detection, autonomous vehicles, medical image analysis, and many others. For example, computer vision algorithms can be used to analyze satellite imagery to detect changes in land use patterns, or to help doctors diagnose diseases from medical images [2].

Image Segmentation.Image segmentation refers to the process of dividing an image into multiple regions or segments, each of which corresponds to a different object or part of the image. The goal of image segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze [3]. Image segmentation has a wide range of applications, including object recognition, medical image analysis, and image editing. For example, image segmentation can be used to separate the foreground of an image (such as a person or a car) from the background, or to identify different structures in a medical image (such as organs or blood vessels) [4].

Investigation of image segmentation methods. There are many different methods for image segmentation, each with their own strengths and weaknesses. Here are a few examples:

1. **Thresholding**: This is a simple method that involves setting a threshold value for a particular image feature (such as color or intensity), and then dividing the image into two segments based on whether each pixel's value is above or below the threshold. This method is often used for binary segmentation, where the goal is to separate the foreground and background of an image. Thresholding is computationally efficient and easy to implement, but it can be sensitive to noise and may not work well for images with complex or variable lighting conditions.

Formal description of the method:

Let I be the input image, and t be the threshold value. The resulting binary image B is given by:

$$B(i,j) = 1$$
 if $I(i,j) > t$
 $B(i,j) = 0$ if $I(i,j) <= t$

In other words, each pixel in the binary image is set to 1 if the corresponding pixel in the input image has a value greater than the threshold value, and 0 otherwise.

2. **Region-based segmentation**: This method involves dividing an image into regions based on similarities in some feature, such as color or texture. A popular algorithm for this is called mean shift, which iteratively shifts the center of each region towards the mean of the pixels in that region

until convergence [5]. Region-based segmentation is robust to noise and can handle complex image features, but it can be computationally intensive and may not work well for images with overlapping or irregular regions.

Formal description of the method:

Let I be the input image, and f be a feature function that maps each pixel (i,j) to a feature vector $f(i,j) = [f1(i,j), f2(i,j), ..., fn(i,j)]^T$. The goal is to partition the image into K regions such that pixels within the same region have similar feature vectors. The mean shift algorithm iteratively shifts the center of each region towards the mean of the pixels in that region until convergence. The update equation is given by:

c(k+1) = (1/N) * sum(i=1 to N) [w(i,k) * f(i)]

$$w(i,k) = exp(-||f(i) - c(k)||^2 / h^2)$$

Where c(k) is the center of region k, N is the number of pixels in region k, w(i,k) is the weight of pixel i in region k, and h is a bandwidth parameter that controls the range of influence of each pixel.

3. Edge detection: This method involves detecting edges (discontinuities) in an image and using them to define the boundaries between segments. Popular edge detection algorithms include Canny edge detector and Sobel edge detector[1]. Edge-based segmentation is often used for detecting objects in images, but it can be sensitive to noise and may not work well for images with low contrast.

Formal description of the method:

Edge detection is based on the observation that abrupt changes in intensity or color in an image correspond to object boundaries. The goal is to detect these changes and use them to segment the image. One popular edge detection algorithm is the Canny edge detector, which involves the following steps:

- gaussian smoothing: Convolve the image with a Gaussian kernel to reduce noise;

- gradient calculation: Compute the gradient of the image using Sobel, Prewitt, or other filters;

 non-maximum suppression: Thin the edges to a single-pixel width by suppressing non-maximum values in the gradient direction;

- hysteresis thresholding: Use two threshold values (high and low) to classify edge pixels as strong, weak, or non-edges. Only strong edges and weak edges connected to strong edges are retained.

The Canny edge detector can be expressed mathematically as:

- smooth the image with a Gaussian kernel: $G(x,y) = (1/2\pi\sigma^2)e^{(-(x^2+y^2)/2\sigma^2)*I(x,y))}$

- compute the gradient magnitude and direction: Gx = I * dx, Gy = I * dy, $G = sqrt(Gx^{2} + Gy^{2})$, $\theta = atan2(Gy, Gx)$;

- suppress non-maximum values: For each pixel (x,y), compare the gradient magnitude G(x,y) to the magnitudes of its neighbors along the gradient direction. If G(x,y) is not the maximum, set G(x,y) to 0;

- thresholding: Define a high threshold T_H and a low threshold T_L . Pixels with gradient magnitude above T_H are classified as strong edges, those below T_L are non-edges, and those between T_L and T_H are weak edges. Perform hysteresis thresholding by connecting weak edges to strong edges.

4. **Clustering**: This method involves grouping pixels into clusters based on similarities in some feature, such as color or texture. A popular algorithm for this is called k-means clustering, which iteratively assigns each pixel to the nearest cluster centroid until convergence [6]. Clustering-based segmentation can handle complex image features and is computationally efficient, but it can be sensitive to initialization and may require careful tuning of parameters.

Formal description of the method

The formula for k-means clustering, which is a popular algorithm for clustering-based segmentation, can be expressed as follows:

- initialize k cluster centroids randomly in the feature space;

- assign each pixel in the image to the nearest centroid;

recalculate the centroids as the mean of the pixels assigned to each cluster;

- repeat steps 2-3 until convergence;

- in this formula, k is the number of clusters to be formed, and the feature space is the space defined by the image features (such as color or texture) used to group pixels into clusters.

K-means clustering is a computationally efficient algorithm that can handle complex image features and is widely used in image segmentation applications. However, it can be sensitive to initialization and may require careful tuning of parameters to achieve optimal results.

2. NEURAL NETWORKS

Neural network definition, types and popular architectures. Neural networks are a type of machine learning algorithm that are inspired by the structure and function of the central nervous system in animals. They consist of layers of interconnected nodes, or neurons, that process information and pass it on to the next layer [7].

If we compare neural networks with the central nervous system, then:

- the input layer of a neural network can be thought of as analogous to the sensory neurons in the peripheral nervous system, which receive information from the environment and send it to the brain; - the hidden layers of a neural network can be thought of as analogous to the interneurons in the central nervous system, which process and integrate information from multiple sources;

- the output layer of a neural network can be thought of as analogous to the motor neurons in the peripheral nervous system, which send signals to muscles or glands to produce a response;

- the weights and biases in a neural network can be thought of as analogous to the strengths of the synapses between neurons, which determine how much influence one neuron has on another.

Neural networks can be trained using a variety of algorithms, such as backpropagation, which adjust the weights and biases of the neurons in response to the training data [8]. This allows the network to learn to recognize patterns and make predictions based on input data.

Neural networks have shown impressive performance in a wide range of applications, including image recognition, natural language processing, and robotics. However, they can be computationally expensive and require large amounts of training data to achieve optimal performance.

There are several types of neural networks, each designed for specific applications. Some of the most popular neural network architectures are:

1. Feedforward neural networks: These are the most basic type of neural network, consisting of input, hidden, and output layers. They are used for tasks such as image and speech recognition, as well as prediction and classification. Popular examples include multilayer perceptrons (MLPs) and convolutional neural networks (CNNs) [7, 9].

2. Recurrent neural networks (RNNs): These networks are designed to process sequential data, such as time-series or natural language text. They use feedback connections to allow information to persist over time, making them well-suited for tasks such as speech recognition and language translation. Popular examples include long short-term memory (LSTM) networks and gated recurrent units (GRUs) [7][10].

3. Convolutional neural networks (CNNs): These networks are designed to process spatial data, such as images or videos. They use convolutional layers to extract local features from the input data, making them highly effective at image classification and object detection. Popular examples include LeNet, AlexNet, and VGG [9, 11].

4. Autoencoder neural networks: These networks are used for unsupervised learning, in which the goal is to learn a compressed representation of the input data. They consist of an encoder network that maps the input data to a lower-dimensional representation, and a decoder network that reconstructs the input from the lower-dimensional representation. Popular examples include denoisingautoencoders and variationalautoencoders [12, 13]. 5. Generative adversarial networks (GANs): These networks are used for generative modeling, in which the goal is to generate new data that is similar to the training data. They consist of two networks: a generator network that produces fake data, and a discriminator network that distinguishes between the fake and real data. The two networks are trained together in a adversarial process, in which the generator tries to produce data that fools the discriminator. Popular examples include DCGAN and StyleGAN [14, 15].

Research of neural network training methods. Training a neural network refers to the process of optimizing the weights and biases of the network through iterative backpropagation of errors. This involves feeding a set of input data into the network, propagating the data through the network, computing the loss or error between the predicted output and the ground truth output, and updating the weights and biases to minimize the loss [7]. The process is repeated over multiple epochs until the network achieves a satisfactory level of accuracy on the training data.

Supervised learning is a type of machine learning where the model is trained on labeled data, meaning that the ground truth output for each input is known. The model learns to predict the correct output by minimizing the error between its predictions and the ground truth labels. Common supervised learning tasks include classification and regression [16]. Unsupervised learning, on the other hand, involves training a model on unlabeled data, where the ground truth output is unknown. The model learns to identify patterns and structure in the data without the need for explicit labels. Common unsupervised learning tasks include clustering and dimensionality reduction [16].

3. INVESTIGATION OF THE USE OF CONVOLUTION NEURAL NETWORKS FOR THE PROBLEM OF IMAGE SEGMENTATION

Convolutional networks for semantic segmentation. Convolutional neural networks (CNNs) are a type of deep neural network designed to process input data with a grid-like topology, such as images [7]. CNNs are composed of multiple layers, including convolutional layers, pooling layers, and fully connected layers, which are trained to extract hierarchical features from the input data. They have become one of the most popular architectures for a wide range of computer vision tasks, including image classification, object detection, and semantic segmentation.

Image segmentation refers to the process of partitioning an image into multiple segments or regions, each of which corresponds to a different object or part of an object in the image [17]. This is typically accomplished using a segmentation algorithm or a neural network-based approach, such as a fully convolutional network (FCN), which outputs a pixel-wise segmentation map for the input image. Image segmentation has numerous applications, including medical imaging, autonomous driving, and robotics.

CNNs are commonly used for image segmentation by modifying their architecture to output a pixel-wise segmentation map for the input image. One popular approach for doing this is the fully convolutional network (FCN) architecture, which replaces the fully connected layers of a traditional CNN with convolutional layers [18]. FCNs are trained end-to-end to predict the class label for each pixel in the input image, resulting in a segmentation map that can be used to identify different objects or regions in the image.

Another approach for using CNNs for image segmentation is the U-Net architecture, which consists of a contracting path that captures the context of the input image and an expansive path that predicts the segmentation mask at a pixel level [19]. The U-Net architecture has been shown to be effective for medical image segmentation tasks.

Investigation of the use of convolution neural networks for image segmentation. Convolutional Neural Networks (CNNs) have been successfully applied to various computer vision tasks such as image classification, object detection, and semantic segmentation. Some popular examples of CNN architectures include AlexNet, VGGNet, ResNet, andInceptionNet [9].

The U-Net architecture was proposed by Ronneberger et al. in 2015 [19] for biomedical image segmentation tasks. The U-Net consists of an encoder path and a decoder path, with skip connections between corresponding layers in the encoder and decoder. The encoder path captures the context of the input image and extracts features at different scales, while the decoder path reconstructs the segmentation mask at the original image resolution. U-Net has been applied to various biomedical image segmentation tasks such as segmentation of cell nuclei, brain tumors, and blood vessels [20, 21].

The SegNet architecture, proposed by Badrinarayanan et al. in 2017 [22], is another example of a CNN architecture for image segmentation. SegNet consists of an encoder network that extracts features from the input image and a decoder network that produces a pixel-wise segmentation mask. SegNet has been applied to various computer vision tasks such as road segmentation in autonomous driving and indoor scene understanding [23].

Conclusion

In this paper, neural networks were considered, the main attention was paid to convolutional neural networks. The classification of neural networks was reviewed, the basic principles of their operation and architectures were described. The methods of training neural networks are considered - with and without a teacher. Neural networks for semantic segmentation of images were considered U-Net and SegNetwere considered, their application to practical problems

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MODERN RADIO DEVICES

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Аннотация. Статья посвящена рассмотрению современных радио устройств. В статье даётся определение понятию «радио устройство». В исследовании рассматривается история создания радио устройств. Описывается основная задача радио устройств. Рассматривается вопрос создания радио устройств. Приводятся основные типы радио устройств.

Ключевые слова: радио, современные, устройства, технологии.

Annotation. The article is devoted to the consideration of modern radio devices. The article defines the concept of "radio device". The study examines the history of the creation of radio devices. The main task of radio

devices is described. The issue of creating radio devices is being considered. The main types of radio devices are given.

Keywords: radio, modern, devices, technologies.

An electronic device is a functionally and structurally complete product designed to perform different tasks (transmission, receiving, storage, or signal conversion) [1].

Electric filters are devices that carry out the separation of signals according to the frequency attributed. The frequency domain that passes through the filter is called the bandwidth, the frequency domain that is not passed through the filter is called the delay band. The frequency separating the bandwidth and the delay is called the cutoff frequency. Filters are classified by frequency range [1].



Picture 1 – Electric Filters

Amplifiers. Amplifier (V) is a device built on active elements and designed to increase the power of the input signal due to the energy of the DC source. The simplest amplifier consists of an amplifying element, a set of passive elements and a source of electrical energythat form an amplifying stage. It has an input circuit which the amplified signal is supplied to, and an output circuit for receiving the output signal [2].

At present, operational amplifiers have been used predominantly due to the large gain, small size and low energy consumption. However, they are not able to amplify high power. In these cases, we use tube or transistor amplifiers. The latter displace tube amplifiers, since they are more economical, are capable of withstanding large powers and are small in size [2].

Generators. Generator is a device that converts energy of the power source (DC source) into oscillations of a given shape.

Depending on the shape of the generated signals, there are distinguished harmonic oscillators (sinusoidal), rectangular pulse generators, saw tooth wave generators [2].

The most common generators are harmonic wave generators. The main characteristics of harmonic wave generators are the frequency and power of the output signals. Most harmonic wave generators are range.

Rectifiers. A rectifier is a device that converts alternating voltage into direct current.



Picture 2 - A Modern Rectifier

The main part of any rectifier is a rectifier diode or a diode group. The diode has one-way conductivity, i.e. if the voltage at its anode is greater than the voltage at the cathode by the amount of voltage drop at the open p - n junction, then the resistance of the diode is small and large current flows through it, otherwise, its resistance is large and small current flows through it [3].

In practice, half-wave and full-wave circuits are the most common as power sources. Half-wave circuits are simple, but use only one half-cycle of an input AC voltage. This leads to large ripples at the output and a 2-fold decrease in the output voltage level. These deficiencies are deprived of fullwave straightening circuits [3].

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RESEARCH OF RECURRENT NEURAL NETWORKS FOR SPEECH RECOGNITION TASK

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Аннотация. Искусственный интеллект – это способность компьютерной системы или машины имитировать человеческий интеллект, включая восприятие, рассуждения, обучение и адаптацию.

Одним из ключевых компонентов искусственного интеллекта являются нейронные сети. Они представляют собой алгоритмы машинного обучения, которые имитируют работу человеческих мозгов, состоящих из нейронов.Нейронные сети могут быть разных типов, включая простые персептроны, сверточные нейронные сети, рекуррентные нейронные сети и глубокие нейронные сети. Каждый тип имеет свои преимущества и недостатки, и выбор конкретного типа нейронной сети зависит от конкретной задачи. В данной статье будет рассмотрена ИЗ области искусственного конкретная залача интеллекта распознавание речи с использованием рекуррентных нейронных сетей. Целью работы является изучение проблемы распознавания речи, типов нейронных сетей и, в частности рекуррентных нейронных сетей, а так же рассмотрение уже известных исследований этой темы и алгоритмов, которые могут быть использованы для этого.

Ключевые слова: распознавание речи, искусственный интеллект, нейронная сеть, рекуррентные нейронные сети.

Annotation. Artificial intelligence is the ability of a computer system or machine to mimic human intelligence, including perception, reasoning, learning, and adaptation. One of the key components of artificial intelligence, are neural networks. They are machine learning algorithms that mimic the way human brains are made up of neurons. Neural networks can be of various types, including simple perceptrons, convolutional neural networks, recurrent neural networks, and deep neural networks. Each type has its advantages and disadvantages, and the choice of a particular type of neural network depends on the specific task. This article will consider a specific task from the field of artificial intelligence - speech recognition using recurrent neural networks. The aim of the work is to study the problem of speech recognition, types of neural networks and, in particular, recurrent neural networks, as well as to consider the already known studies of this topic and algorithms that can be used for this.

Keywords: speech recognition, artificial intelligence, neural network, recurrent neural networks.

1. STATEMENT OF THE SPEECH RECOGNITION PROBLEM

Artificial intelligence and neural networks. Artificial intelligence (AI) is a field of science that implements algorithms and systems that can perform tasks that require the intelligence normally associated with human intelligence. Neural networks are one of the key components of AI. They are machine learning algorithms that mimic the way human brains are made up of neurons. Neural networks can be of various types, including simple perceptrons, convolutional neural networks, recurrent neural networks, and

deep neural networks. Each type has its advantages and disadvantages, and the choice of a particular type of neural network depends on the specific task. The use of neural networks in AI allows significant advances in areas such as speech recognition, natural language processing, computer vision, autonomous navigation, and many others. However, the development and optimization of neural networks is a complex and ongoing process that requires a large amount of data and computational resources.

Speech recognition. The task of speech recognition is to convert an audio signal containing voice speech into text form. This task can be solved using various machine learning algorithms, including recurrent neural networks. Speech recognition has many applications, including voice control systems, automatic audio transcription, video captioning, speech analysis, and many others. However, this task remains challenging because audio signals can contain noise, echo, distortion, and other artifacts that can make accurate speech recognition difficult. To solve this problem, various methods and approaches are used, including the use of large amounts of data for training models, the use of optimization algorithms, the use of ensembles of models, and many others. Currently, the task of speech recognition continues to be an active area of research in machine learning and artificial intelligence.

Investigation of recurrent neural networks for speech recognition.Speech Recognition is also known as Computer Speech recognition which means making the computer understand what we speak. In general program, a computer such that it can hear us and respond us. By "understand" we mean it would convert our voice into appropriate format for e.g. Text. Thus speech recognition is also called as Speech to Text conversion process .It consists of microphone for humans to speak, recognition of speech software and a computer to perform task. The basic recognition of speech system is shown in fig 1.



Fig.1 – Speech Recognition system

We have to fed sound waves in computer for converting it into text. As sound waves are continuous (analog) signal the first thing to perform is sampling of signal using Nyquist theorem. This sampled signal directly to our neural network but pre-processing of signal is done in order to get better result and accurate predictions of spoken words. Pre-processing is grouping of a large sampled signal into 20-milliseconds small chunks. Preprocessed sampled data which is in digital format is now fed to our Recurrent Neural Network (RNN) which is our main speech recognition model used for prediction. Models used in STT Engine are discussed in further sections.

Sampling and pre-processing of data is important step while designing STT Engine .This step decide the performance and time consumption of the engine. Sound waves are one-dimensional. At every moment in time, they have a single value based on the magnitude of the wave. To turn this sound wave into number just record the magnitude of the wave at equally-spaced points. This scalled as Sampling shownin fig. 2.



Fig. 2 – Samplingofspeechsignal

Sampling rate is decided using nyquist theorem it is mostly 1/16000th seconds interval. Math is used to perfectly reconstruct the original sound wave from the spaced-out samples with sampling frequency equal to or twice more than of highest frequency at which it is recorded. This sampled data directly fed to our recurrent neural network but for ease and better results data is preprocessed before applying to the network[2].

Fig. 3 shows speech recognition using RNN. Now audio which is given at input is easy to process, it will be feed into a deep neural network. After feeding small audio chunks of around 20ms to our network it will figure out letter which matches the spoken sound.



Fig. 3 – Speech Recognition Model

RNN is a network which has a memory that decides the future predictions. This is because as it predicts one letter it will affect the likelihood of the upcoming letter which it will predict too.

RNNs uses the idea of sequential information. RNN, a neural network that has a memory that influences future predictions Sequential information which is stored in memory of RNNs is used for predictions. Idea to use RNN instead of traditional neural network is in traditional neural network it is assumed that every input & every output are doesn"t depends on each other. Hence using traditional neural network is bad idea in speech processing.Prediction of any words in a sentence requires the information about the word which is utilised before i.e. past word which is processed. Having a memory is one of the speciality of RNN that makes it unique than other networks There are various neural networks available among them the Recurrent Neural network [RNN] is used because it is more efficient than the others for speech recognition.

Algorithm. Steps involved in RNN algorithm is :Xt is input at time t, Xt-1 is past input and Xt+1 is the future input (sampled sound) II. St is the hidden state. It is the hidden memory. St is calculated as: St = f(U*Xt + W*Xt-1). Ot is output at the step t .For example if we want to predict the next word in a sentence it Would be a vector of probabilities across our vocabulary ,Ot=softmax(V*St)



Fig. 4 – RNN algorithm

5. LONG SHORT-TERM MEMORY

LSTM is a type of recurrent neural network with a strong ability to learn and predict sequential data[3]. Sequence prediction is a long-standing problem. With recent advancements in the field of data science, it is found that for practically all sequence prediction problems, LSTM has been observed as the most successful approach. The core idea behind LSTMs is the cell state and its gates. The cell state conveys the relevant information to the sequence chain.



Fig. 5 – The standard LSTM RNN architecture

The main structure of LSTM consists of unique segments known as "memory blocks" in the hidden layer. The first type of LSTM block consists of cells and the input and output gates. The standard structure of LSTM has a limitation, which was addressed for the first time in through the establishment of a "forget gate" that will empower LSTM to adjust its state. The "forget gate" if resets the cell variable leading to the 'forgetting' of the stored input ct, whereas the input and output gates manage the reading of inputs from the feature vector, xt , and writing of output to ht, respectively. The gates regulate the action of the memory block whereas the "forget gate" weighs the information inside the cells, such that anytime previous information becomes unimportant for some cells, it will reset the state of the different cells. "Forget gates" also enables continual prediction, by making cells forget their previous state, thereby restricting biases in prediction.

6. A NEURAL ATTENTION MODEL FOR SPEECH COMMAND RECOGNITION

Since the audio files contain a single word command that can be anywhere in the 1s length of the WAV file, it is reasonable to assume that any model that is able to classify an audio should also be able to find what is the appropriate region of interest. Thus, the attention mechanism seems appropriate to this particular task.

The model starts by computing the mel-scale spectrogram of the audio using nontrainable layers implemented in the kapre library. The input to the model is the raw WAV data with original sampling rate of ~16 kHz. Mel-scale spectrogram is computed using 80-band mel scale, 1024 discrete Fourier transform points and hop size of 128 points (~8 s). Similar parameters have been successfully used for audio synthesis (Wang et al. (2017)) and we noticed that they preserve the visual aspect of the voice formants in the spectrogram.

After mel-scale spectrogram computation, a set of convolutions is applied to the melscale spectrogram (2D output) only in the time dimension to extract local relations in the audio file. A set of two bidirectional long short term memory (LSTM - Hochreiter and Schmidhuber (1997)) units is used to capture two-way (forward and backward) long term dependencies in the audio file[1].

At this point, one of the output vectors of the last LSTM layer is extracted, projected using a dense layer and used as query vector to identify what part of the audio is the most relevant. We choose to use the middle vector of the LSTM output since the voice command is expected to be centered in the audio files. This choice is arbitrary and any vector should work since the double stacked LSTM layers should be able to carry enough "memory".

Finally, the weighted average of the LSTM output is fed into 3 fully connected layers for classification. Figure 1 summarizes the architecture.



Fig. 6. – Speech Recognition Model

Proposed architecture: recurrent neural network with attention mechanism. Numbers between [brackets] are tensor dimensions. rawlen is WAV audio length (16000 in this case). specIen is the sequence length of the generated mel-scale spectrogram. nMel is the number of mel bands. nClasses is the number of desired classes. The activation of the last Dense layer is softmax. The activation of the 64 and 32 dense classification layers is the rectified linear unit (relu).

Conclusion

Within the framework of this paper, the problem of speech recognition was investigated, approaches to solving this problem, as well as popular algorithms that are currently used, were considered. Next, the classification of neural networks and the most popular network architectures were considered. The application of recurrent neural networks for the task of speech recognition is investigated on the example of popular science works on this topic. In particular, works on the use of recurrent networks with shortterm long-term memory are considered.

To implement such neural networks, various algorithms can be used, there are many methods and architectures that must be chosen based on a specific task.

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UDC 621

EXPLORING THE USE OF 5G NETWORK EMULATION SOFTWARE

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Аннотация. В статье рассмотрено применение программного обеспечения для выполнения задачи эмуляции сети 5G и тестирования её параметров на соответствие их со стандартами ЗGPP. Проведен обзор представленных программ для эмуляции сетей 5G и сделан вывод о необходимых для эмуляции параметрах программного обеспечения. Проведено исследование особенностей взаимодействия интерфейсов между собой, а также особенностей их подключения при их симуляции программном обеспечении.Сделан вывод в 0 необходимости проведения практических исследованийдля подтверждения соответствия требованиям партнерского проекта 3GPP.

Ключевые слова:Мобильные сети,5G,эмуляция работы мобильной сети, интерфейсы сети 5G,3GPP.

Annotation. The paper considers the application of software to perform the task of emulation of 5G network and test its parameters for their compliance to 3GPP standards. The presented software for emulation of 5G networks is reviewed and a conclusion about necessary software parameters for emulation is made. The study of peculiarities of interaction between interfaces, as well as peculiarities of their connection during their simulation in the software is conducted. It is concluded that practical research is needed to confirm compliance to the 3GPP partner project.

Keywords: Mobile networks, 5G, mobile network emulation, 5G network interfaces, 3GPP.

INTRODUCTION

The 5G mobile network is currently one of the most advanced networks in the world. But unfortunately, at this time in Russia this generation network has only been deployed in test mode in a few areas of major cities. And in order to explore the possibilities of 5G we can use software to emulate the network operation.

OVERVIEW OF EMULATION SOFTWARE

Let's take a look at the 5G network emulation software available on the market today. It can be seen that mostly the offered functionality and structural design of such emulators are identical.

First is the GL automation messaging protocol simulation software (MAPSTM) [5], created by GL Communications. It is a feature-rich package that provides various emulations, ranging from time-domain multiplexing (CAS, SS7, ISDN, etc.) to wireless networks. It can be used to test and troubleshoot network infrastructure and user equipment (UE) and ensure network compliance.

Another option is NetSim [2], which is a 5G NR network simulation tool in general. This software has a graphical interface and the ability to perform network measurements, but it can only handle a limited number of frequency bands. Like MAPS, NetSim can only do a virtual network emulation, which means that it is not possible to simulate a real network.

Open5GS [6] together with UERANSIM [4], which is open source, can also be distinguished. They can emulate not only the 5G mobile network but also user equipment. At the same time, they do not have the ability to test the performance of the network itself.

Of particular note is the SRSRAN [8] project which is open source, able to work with different frequency bands and still be able to perform real network emulation via LimeSDR.

Having reviewed the presented 5G emulation software, it can be concluded that the SRSRAN project is the most suitable for further research into network capabilities, with significant advantages over competitors.

FEATURES OF INTERFACE EMULATION

The 3GPP organisation distinguishes the following interfaces for gNB [1, 3, 4, 9]:

- Xn - interface between gNB base stations.

- N2 is the control plane interface between the gNB and the 5GC core network access control and mobility module (AMF).

- N3 is the user traffic plane interface between the gNB and the 5GC core network user traffic transmission module (UPF)

- RRC (Radio Resource Control) - A protocol designed for radio resource control. The functions of the RRC protocol are:

- RRC connection control (RRC connection control);

- management of inter-RAT mobility mechanisms;

- measurement and reporting;

- Non Access Stratum (NAS) signalling traffic.

- SDAP (Service Data Adaptation Protocol) - performs quality management (QoS) functions, including:

- marking data packets with the appropriate QFI (QoS Flow ID) parameters by DL and UL direction;

- determines the correspondence between data flows with corresponding QoS parameters and virtual channels (DRB - data radio bearer).

- PDCP (Packet Data Convergence Protocol) - realises the following functions:

- exchange of user data and control plane data;

- performs packet numbering;

- performs encryption and data integrity control;

- restores packet order, removes duplicates; provides increased transmission reliability through packet duplication.

- RLC (Radio Link Control) RLC level is designed to:

- transmission of packets generated by the higher layers (PDCP);

- detection and correction of transmission errors;

- detection of duplicate RLC PDUs;

- deletion of data at the request of the higher PDCP level.

- MAC (Medium Access Control) performs the following functions:

- Matching between logical and transport channels;

- multiplexes data blocks belonging to one or more logical channels into transport blocks;

- demultiplexing the data blocks received in transport blocks from the physical layer;

- dynamic allocation of resources taking into account the priorities of user terminals.

To emulate these interfaces the following is required:

- installZeroMQadd-on;

- To write the necessary commands for their interaction with each other.
Conclusion

Having carried out this study, the following results have been obtained:

- Conducting research in the field of mobile 5G network operation and testing its parameters in the absence of base stations in the locality can be done by emulation of the network by means of special software;

- To date, there is a wide variety of software for 5G network emulation and testing. The most preferred software is SRSRAN project, which has the ability to carry out both network visualization and practical investigation of the interaction between the mobile device and the base station;

- The features of 5G network interfaces emulation have been identified.

In the future, it is planned to conduct practical studies of 5G network using SRSRAN and LimeSDR.

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Аннотация. Рассчитаны геометрические параметры, построена диаграмма направленности составляющих поля двухпроходной цилиндрической антенны. Описаны основные элементы конструкции антенны.

Ключевые слова: спиральная антенна, цилиндрическая антенна, многопроходная антенна, вращающаяся поляризация.

Annotation. The geometrical parameters are calculated, the radiation pattern of the components of the field of a two-pass cylindrical antenna is constructed. The main elements of the antenna design are described.

Keywords:helical antenna, cylindrical antenna, multi-pass antenna, rotating polarization.

Introduction

A two-way cylindrical helical antenna forms a radiation pattern close to isotropic. Broadband matching with the power line is carried out by a segment of a two-wire line with a smoothly changing impedance. The antenna has no analogues in terms of a set of parameters: it can operate without a gyrostabilized platform, in a wide frequency band and at high pressure of a shock air wave.

It is required to develop an antenna for a frequency of 0.9 GHz, a bandwidth of 100 MHz, with a circular polarization type.

Mainpart

Cylindrical helical antennas are antennas that are designed to convert electromagnetic waves into an electrical signal (receiver) or to radiate electromagnetic waves into the external environment (transmitter). They consist of a wire that is helically wound onto a cylindrical frame and is shaped like a cylindrical coil.

Cylindrical helical antennas are widely used in various communication systems, including radio, television, satellite communications, radar, etc. They perform well at high frequencies and are highly efficient and accurate, but can be expensive to manufacture and may have limited range.

In general, cylindrical helical antennas remain one of the most efficient and versatile solutions for transmitting and receiving radio signals over long distances. Due to their accuracy and stability, as well as the ability to use at high frequencies, they are widely used in science, industry and communications, contributing to the improvement of technology and people's living conditions.

The geometrical changes of the antenna are calculated according to the method described in [1]. The radius of the generating cylinder is 6.3 cm; conductor winding pitch 7.1 cm; number of turns 8.5.

To describe the mathematical model of the radiation field of the developed antenna [2], it is necessary to write formulas for determining the components of the vector potential A_x , A_y , A_z , we write the expression for A_x since for A_y , A_z , they are similar

$$A_{\chi} = \frac{\mu_0}{4\pi} \frac{\theta^{-\beta(R)}}{R} I_0 \int_{\alpha} \exp\left[-jkS(\alpha)\right] \times$$

 $\times \exp[jk[x(\alpha)\sin(\theta)\cos(\varphi) + y(\alpha)\sin(\theta)\sin(\varphi) + z(\alpha)\cos(\theta)]dx(\alpha).$

The components of the vector potential $A\theta$ and $A\phi$ in the spherical coordinate system can be expressed in terms of A_x , A_y , A_z , using the relations:

 $A_{\theta}(\theta, \phi) = A_{x\Sigma}(\theta, \phi) \cos(\theta) \cos(\phi) +$

$$+A_{y\Sigma}(\theta,\phi)\cos(\theta)\sin(\phi) - A_{z\Sigma}(\theta,\phi)\sin(\theta),$$
$$A_{z}(\theta,\phi) = -A_{x}(\theta,\phi)\sin(\phi) + A_{x}(\theta,\phi)\cos(\phi).$$

 $A_{\varphi}(\theta, \varphi) = -A_{x\Sigma}(\theta, \varphi) \sin(\varphi) + A_{y\Sigma}(\theta, \varphi) \cos(\varphi) \cdot$ Beamwidth for components $A_{\theta}(\theta, \varphi)$ and $A_{\varphi}(\theta, \varphi)$ with $\phi = 0$ H $\phi = \pi / 2$ is and 34°

29° and 34°.

One of the main characteristics of the radiation field of helical antennas is the parameters of an elliptically polarized wave and, in particular, the ellipticity factor.

As a result of modeling in the CAD Feko program, the input impedance of the antenna was calculated, the value of which was 50 Ohm.

Based on the calculations of the characteristics of the helical antenna for certain values of geometric parameters, the design of the antenna was developed. The design of a two-way cylindrical helical antenna contains: a supporting frame; two spiral conductors; reflective screen; microwave connectors; antenna fastening elements on the supporting structure; a radio-transparent protective cap to protect the antenna from mechanical damage (made of fiberglass, fiberglass or polystyrene).

Conclusion

Thus, a cylindrical two-way helical antenna has been developed. The characteristics of this antenna are as follows:

— the coefficient of ellipticity is 0.972, which corresponds to circular polarization;

— antenna gain is 25.

It was possible to obtain an input impedance of the antenna equal to 50 ohms, as a result of which there is no need to use a matching circuit at the antenna output.

The antenna of this range can be used in radio communication systems. **References:**

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UDC 621.3

EXCITATION OF AN EQUAL-PIT SPIRAL ANTENNA

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Аннотация. Рассмотрены способы возбуждения четырехпроводной спиральной антенны. С помощью пакета программ САПР Feko было смоделировано антенну и проанализированы параметры антенны: входное сопротивление, коэффициент усиления, эллиптичность. Рассчитаны диаграмма направленности и зависимость коэффициента эллиптичности от угла места.

Ключевые слова: спиральная антенна, равношаговая антенна, многопроходная антенна.

Annotation. Methods for excitation of a four-wire spiral antenna are considered. Using the CAD Feko software package, the antenna was modeled and the antenna parameters were analyzed: input impedance, gain, ellipticity. The radiation pattern and the dependence of the ellipticity coefficient on the elevation angle are calculated.

Keywords: spiral antenna, equal-pitch antenna, multi-pass antenna.

Introduction

Currently, a large number of multi-entry antennas are used in telecommunications. One of the advantages of a multi-pass antenna from a single-pass antenna is a larger coefficient of ellipticity, a radiation pattern that is more symmetrical, and better circular polarization [1].

The report explores the optimal way to include a four-start Archimedes spiral. Namely: the effect of changing the phase shift clockwise and counterclockwise is investigated.

Mainpart

Spiral antennas are a type of antennas that have unique properties such as broadband and wide beam angle. They use spiral shapes to create an RF signal to transmit or receive data. Planar helix antennas are widely used in various fields such as wireless networks, telecommunications, medical and scientific diagnostics, ultra-wideband signal imaging and testing, military equipment, and others. They can also be made from a variety of materials such as printed circuit boards, metal foils and fabrics, allowing them to be compact and easy to manufacture. Flat spiral antennas can radiate a right or left polarized field.

Spiral antennas make it possible to radiate and receive a field with a rotating polarization, which can be important for the case of arbitrary orientation of the transmitting and receiving antennas.

The antenna has four entries, which allows it to be excited in various ways.

The antenna has a weakly directional radiation pattern

In addition, it is important to take into account the parameters of the antenna when designing it. With the Feko CAD software package, antenna parameters such as input impedance, gain, and axial ratio can be modeled and analyzed. This will help optimize its operation and increase the efficiency of signal transmission.

Feko includes a range of analytical and numerical methods for solving electromagnetic problems, including Method of Moments (MoM), Finite Element Method (FEM), and Finite Difference Time Domain (FDTD). It also supports a wide range of 3D CAD file formats, making it easy to import and analyze complex geometries.

The antenna is examined at a frequency of 700 MHz. Compared parameters such as input impedance, gain, ellipticity factor.

As a result of modeling, the following data were obtained. The input resistance when changing the direction of the installation of the phase did not change and amounted to 51 Ohm; the gain was 6.3 and also did not change; the radiation pattern also did not change.

The maximum of the ellipticity coefficient is observed not at 0 degrees, but at 180 degrees, from which we can conclude that the direction of circular polarization has changed from right to right.



Fig. 1 – The dependence of the coefficient on the elevation angle

This effect can be exploited for high power DBS satellites where all channels typically have one fixed polarization direction, either left or right. Neighboring DBS satellites, if their service areas are not sufficiently separated from each other, typically use signals with opposite polarization directions to prevent interference. The use of cross-polarization on neighboring satellites leads to suppression of interference by more than 20 dB [3].

Conclusion

Thus, the dependence of the characteristics of the antenna on the change in the phase shift clockwise and counterclockwise has been studied. This type of inclusion can be used on high power satellites located close enough to each other.

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DYNAMIC ANALYSIS OF MALICIOUS CODE USING THE PYTHON PROGRAMMING LANGUAGE

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Аннотация: В данной статье рассматривается вопрос как при помощи языка программирования Python создать инструмент для исследования образцов вредоносных программ.

Ключевые слова: язык программирования, процесс, событие, реестр, мониторинг, анализ, вредоносный код, АРІ-функции.

Annotation: This article discusses how to use the Python programming language to create a tool for investigating malware samples.

Keywords: programming language, process, event, registry, monitoring, analysis, malicious code, API functions.

Introduction.

Modern malicious software is created in such a way that it is not possible to analyze it with known debugger programs. The creators design their programs so that they monitor and block the work of popular utilities for monitoring the file system, processes and registry changes in the Windows operating system. The purpose of this article is to create your own tool for the study of malware samples. This will allow analyzing malicious software unnoticed by him.

The main part.

There are two types of system analysis: static and dynamic. The first involves examining the executable file without running it, for example, using the source code of the application. An abstract model of the program is created, which is the object of analysis. In dynamic analysis, the sample is directly launched and everything that happens in the event system is monitored. In most implementations, the occurrence of false positives is excluded, since errors will be detected only when they occur in the program. Which guarantees the accuracy of these errors, unlike static analysis, which only predicts the occurrence of these errors based on the analysis of the program model. When investigating malware, it is most interesting to consider operations with file objects and the registry, as well as all cases of creating and destroying processes. To get a more complete picture of the analysis of the object under study, it is necessary to track its API function calls. It should be taken into account that dynamic analysis must be carried out in an isolated environment using a virtual machine or a sandbox.

There are many popular applications created to investigate file system changes, monitor the creation and destruction of processes and threads, and display what is happening in the registry. For example, the Process Monitor and API Monitor utilities. But their main drawback is their fame. Many attackers create their malicious software in such a way that the use of these utilities becomes impossible. To create the possibility of analyzing such malware, this article discusses the option of writing your own tools that will be able to perform the necessary functions for the survey.

To create such a tool, the Python programming language will be used. To track events with the file system and registry, you need to use the WMI (Windows Management Instrumentation) mechanisms, to track API function calls, you need to use the WinAppDbg module.

Process tracking:		
import		wmi
notification_filter process_wathcer =	= wmi.WMI().Win32_Process.watch_	'creation' for(notification_filter)
while new proces	=	True:
print(new_process.Caption	n)	process_watheer()

print(new_procces.CreationDate)

In the first line, the wi module is connected. Next, a notification filter variable is created, which can take 4 values:

1. "operation" — responds to all possible operations with processes;

2. "creation" — responds only to the creation (launch) of the process;

3. "deletion" — reacts only to the completion (destruction) of the process;

4. "modification" — responds only to changes in the process.

Next, a process_watcher observer object is created, it will be triggered every time an event with processes occurs. This event is determined by the notifycation_filter variable. Next, an infinite while loop is started, in which the name and start time of the running process are output.

To run each process in a separate thread, for example, changing processes in one, destroying processes in another, a class is created.

class	s			ProcessMonitor():
def	init(self,	not	ification_filter	='operation'):
	self.process_property		=	
'Caj	ption':			None,
'Cre	eationDate':			None,
'Pro	cessID':			None,
	<pre>} self.process_watcher = notification_filter)</pre>		wmi.WMI().Wi	n32_Process.watch_for(
def	,			update(self):
	process =	=		self.process_watcher()
	self.process_property['EventTy]	pe']	=	process.event_type
	self.process_property['Caption'	j	=	process.Caption
	self.process_property['Creation	Date']	=	process.CreationDate
	self.process_property['ProcessII	D']	=	process.ProcessID

@property def return	event_type(self): self.process_property['EventType']
@property	
def	caption(self):
return	self.process_property['Caption']
@property	
def	creation_date(self):
return	self.process_property['CreationDate']
@property	
def	process_id(self):
return self.process_property['ProcessID']	• • • •

After initializing the class, a list of process_property properties is created in the form of a dictionary, and then the process observer object is defined. Using the update() method, the process is updated, at the moment when the event occurs, the event_type, caption, creation_date, process_id methods declared as class properties receive the values of the corresponding fields from the list of process properties.

A class for starting a process in a separate thread:

	class			Monitor(Thread):
def		init	_(self,	action):
	selfaction		=	action
	Threadinit(self)			
def				run(self):
	print('Start			monitoring')
	pythoncom.CoInitialize()			
	proc_mon	=		ProcessMonitor(selfaction)
whi	le			True:
	proc_mon.update() print(proc_mon.creation_dat	æ,		
	proc_mon.event_type,			
	proc_mon.caption,			
	proc_mon.process_id			
)			
	pythoncom.CoUnitialize()			

Starting monitoring of process events in separate threads: mon_creation = Monitor('creation') mon_creation.start()

Events that need to be tracked are entered in the parameters of the Monitor class, for example, 'creation' – the process creation event.

Rur	n 🯓 dy	Ialalysis
	+	C:\Users\gow\AppData\Local\Programs\Python\Python37-32\python.exe "D:/Python/Dynamic analysis/dynalalysis.py"
1	11.	Start monitoring
	+	19/11/2022 17:23:44 creation conhost.exe 1104
L III	9-9	19/11/2022 17:23:44 creation python.exe 4568
		19/11/2022 17:23:44 creation python.exe 5304
		19/11/2022 17:23:44 creation conhost.exe 5844
-		19/11/2022 17:23:48 creation SearchFilterHost.exe 1996
, Q°	-	19/11/2022 17:23:51 creation python.exe 1604
x		19/11/2022 17:23:51 creation conhost.exe 4988
		19/11/2022 17:23:58 creation screenshot_editor.exe 3956
?		19/11/2022 17:24:00 creation browser.exe 2792
		19/11/2022 17:24:00 creation conhost.exe 4264
		19/11/2022 17:24:00 creation python.exe 5868
		19/11/2022 17:24:01 creation browser.exe 5980
		19/11/2022 17:24:04 creation browser.exe 1284
		19/11/2022 17:24:04 creation browser.exe 4500
		19/11/2022 17:24:07 creation conhost.exe 3084
		19/11/2022 17:24:07 creation python.exe 5784
,		19/11/2022 17:24:11 creation screenshot_editor.exe 1700
		19/11/2022 17:24:12 creation python.exe 1704
8	Pythor	Console 💿 Terminal 🕨 🛓: Run ি 💁 TODO

Fig. 1 – Results of the Python script for tracking the event of creating processes with the usual time format.

Conclusion.

The article shows how using the Python programming language and several useful modules, you can get a sufficient amount of information about events occurring in the system. This can and should be used by an information security specialist to analyze malicious software.

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WINDOWS KERNEL OVERVIEW

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Вэтойстатьепредставленобзорядра Windows, Аннотация. включаярежимядра, компонентыядра Windows, архитектуруядра, атакжесредстваотладкиядра Windows. В статье объясняются основные Ядра, компоненты такие как диспетчер процессов, диспетчер виртуальной памяти, диспетчер ввода-вывода, контрольный монитор безопасности и менеджер подключи и играй, а также то, как они работают вместе для поддержания эффективного функционирования операционной системы. В статье также объясняется важность наличия хорошо продуманной архитектуры ядра, которая является основополагающей для стабильной и надежной операционной системы. Кроме того, в нем подчеркивается важная роль отладки ядра Windows и инструментов для выявления, анализа и устранения неполадок в режиме ядра.

Ключевые слова: ядро Windows, Архитектура ядра, Компоненты ядра, Отладка, Операционная система.

Annotation. This article provides an overview of the Windows Kernel, including Kernel mode, Windows Kernel Components, Kernel architecture, and Windows Kernel Debugging and Tools. The article explains the essential components of the Kernel, such as the Process Manager, Virtual Memory Manager, I/O Manager, Security Reference Monitor, and Plug and Play Manager, and how they work together to maintain the efficient functioning of the operating system. The article also explains the importance of having a well-designed kernel architecture, which is fundamental for a stable and reliable operating system. Additionally, it highlights the essential role of Windows Kernel Debugging and Tools in identifying, analyzing, and troubleshooting errors in the kernel mode.

Keywords: Windows Kernel, Kernel architecture, Kernel Components, Debugging, Operating System.

I. Introduction

Windows Kernel is a crucial component of the Windows Operating System that is responsible for managing system resources, such as memory, CPU time, and input/output operations. Understanding the Windows Kernel and its components is essential in troubleshooting problems that may arise in the system. In this article, we will discuss the different components of Windows Kernel, their functions, and their importance in maintaining the stability and security of the system. We will also explore the Windows Kernel Architecture and the tools used in debugging and testing the Kernel. By the end of this article, you will have a better understanding of Windows Kernel Components and will be equipped with knowledge on how to diagnose and resolve system issues.

II. Windows Kernel mode

Kernel mode is a privileged operation mode in the Windows Operating System that allows direct access to system resources, including hardware components and system memory. The Kernel serves as a mediator between applications and system resources. In Kernel mode, the applications can execute instructions and send commands to the hardware without any restrictions. However, the Kernel mode has limitations in terms of security and stability. Unauthorized access to the Kernel mode can cause the system to crash or freeze.

Kernel mode imposes several permissions and restrictions as a safety measure to protect the system from unauthorized access. These restrictions include limited memory usage, no permission to access user's address space, and restricted access to several resources.

The main difference between Kernel and User mode is the level of access that each mode provides. In User mode, applications run with restricted permissions, and access to system resources is mediated through the Kernel. User mode processes have no direct access to hardware resources like CPU, RAM, network, etc. On the contrary, in Kernel mode, the applications can directly access the hardware resources, without relying on any user input or intervention.

III. Windows Kernel Components

Windows Kernel Components are essential modules that work in conjunction with each other to ensure the efficient functioning of the Windows Operating System. These components are responsible for managing resources such as memory, input/output operations, and hardware devices. Below are some critical Windows Kernel Components.

The Process Manager module is responsible for creating, managing, and terminating system processes. In simple terms, it tracks all running processes in the system and assists the operating system in functionality. The Process Manager allocates memory and other system resources such as CPU time, input/output operations to processes efficiently.

The Virtual Memory Manager module is responsible for managing the allocation of memory to processes. The module creates and manages virtual memory by translating the addresses of requested memory objects into actual physical memory locations using paging. This helps run multiple processes concurrently without compromising the system's performance or stability.

The I/O Manager module is responsible for managing input/output (I/O) operations within a computer system. It provides a common I/O interface that system components and drivers can use to communicate with each other, and it optimizes the utilization of system resources to ensure that I/O operations run smoothly.

The Security Reference Monitor module is responsible for enforcing security policies in the Operating System. It provides a mechanism that

allows the system to authenticate users, authorizes access to system resources, and audits system activity to ensure compliance with security policies.

The Plug and Play Manager module is responsible for managing hardware devices installed on the computer. The module auto-detects new hardware added to the system, and it automatically installs the necessary drivers and sets up the device for use.

IV. Windows Kernel Architecture

Windows Kernel Architecture defines the structure and design of the Windows Kernel. It is the foundation of the Windows operating system and plays a crucial role in the performance and stability of the system.

The Windows Kernel Architecture consists of four main layers, each with specific functions. The first layer is the Hardware Abstraction Layer (HAL), which provides a platform-independent interface for the operating system to communicate with hardware devices. The second layer is the Kernel Executive, which manages system resources such as memory management, process scheduling, and I/O operations. The third layer is the Kernel Services, which provides essential services to the upper layers of the operating system. Finally, the fourth layer is the User Interface, which is responsible for providing the graphical user interface of an application [2].

The Hardware Abstraction Layer (HAL) layer communicates directly with hardware devices, and its primary function is to abstract the hardwaredependent details. HAL provides a layer of insulation between the hardware and the operating system, allowing the operating system to communicate with hardware devices easily.

The Kernel Executive layer manages system resources such as memory management, process scheduling, and provides other essential functions required by the operating system. This layer comprises several sub-components, such as the memory manager, process manager, I/O manager, and security reference monitor [3].

The Kernel Services layer builds on top of the Kernel Executive layer and provides essential services required by the upper layers of the operating system. These services include file system access, synchronization, and interprocess communication.

The User Interface layer provides the graphical user interface of an application. It includes components such as the Windows API, the Desktop Environment, and the Window Manager.

Having a well-designed kernel architecture is crucial for proper functioning and performance of the operating system. A well-designed architecture ensures that the operating system can efficiently manage system resources, handle exceptions and faults, and provide a stable environment for applications to run. It also allows the system to scale up as the hardware evolves without significant changes to the architecture. In summary, having a well-designed architecture is a fundamental aspect of the Windows Kernel, which plays a crucial role in ensuring the stability and performance of the operating system [1].

V. Windows Kernel Debugging and Tools

Windows Kernel Debugging Tools provide various solutions for debugging and testing Kernel mode code. These tools are designed to assist developers and system administrators in identifying and troubleshooting issues with the kernel.

The Windows Debugging Environment (WinDbg) is the primary Windows Kernel debugging tool. It is a powerful command-line tool that provides real-time analysis of system errors. WinDbg can be used to debug device drivers, the kernel itself, and user mode applications. It offers an extensive set of commands and features to analyze system memory, thread execution, CPU registers, and I/O operations.

The Kernel Debugger (KD) is another essential tool in Windows Kernel Debugging. It is a command-line tool that allows debugging of the Windows kernel remotely. KD utilizes the remote debugging protocol and supports both cable and network connections.

Microsoft Visual Studio Debugger is a well-known debugger for usermode applications. It provides debugging support for the Windows kernel by installing kernel-mode debugging components. This tool offers an interactive and user-friendly graphical interface, which makes debugging the Kernel mode easier.

Apart from the above tools, other tools such as Process Explorer, Performance Monitor, Windows Driver Verifier, and Debugging Tools for Windows provide additional options for debugging and testing. These tools assist developers in analyzing and troubleshooting kernel-mode errors and performance issues.

VI. Conclusion

In conclusion, having a better understanding of the Windows Kernel Components, Kernel architecture, and debugging tools is essential for diagnosing and resolving system issues while ensuring proper functioning and performance of the operating system.

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PAPER DOCUMENTS CONTOUR DETECTION ALGORITHM

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Аннотация. В статье рассматривается алгоритм поиска контуров на изображении. Проведен анализ алгоритмов фильтрации краев, размытия изображения, контурного анализа. На основе проведенного анализа можно сделать вывод, что алгоритм является достаточно эффективным решением для подготовки изображения к дальнейшей обработке.

Ключевые слова: алгоритм, компьютерное зрение, контур, обработка изображения, фильтрация, сканер.

Annotation. The article describes the algorithm for searching for image contours. The analysis of algorithms for filtering edges, blurring an image, and contour analysis has been carried out. Proposed algorithm is aimed on paper documents edges contour detection.

Keywords: algorithm, computer vision, contour, image processing, filtering, scanner.

Introduction

Currently, edge detection algorithms are used in many image processing and computer vision algorithms. The search for contours is based on one of the basic properties of the luminance signal - discontinuity. The most common way to search for discontinuities is to calculate derivatives or brightness gradients of images, which can be performed by means of spatial filtering.

The paper proposes an algorithm for detecting contours, which is applicable in solving the problem of creating a similarity of a scanned copy of documents from their photographs.

Main part

To highlight the area of interest corresponding to the document, such features as the number of corners and the area of the geometric figure are used.

The block diagram of the document outline search algorithm is shown infig. 1.



Fig.1 — Block diagram of the algorithm

In order to reduce the number of edges, Gaussian blur is applied to the brightness image.

Next, a Canny edge detector is applied, which results in a binary image with edges corresponding to sharp changes in brightness. The Canny detector involves the steps of calculating gradients, extracting gradient maxima, double threshold filtering, and analyzing edge connectivity.

At the gradient calculation stage, the image brightness is differentiated using several spatial filters to calculate gradients in the horizontal, vertical, and diagonal directions.

At the stage of selecting the gradient maxima, a search is made for local maxima corresponding to the edges of objects in the image (Fig. 2).



Fig. 2 — Search for highs

At the stage of double threshold filtering, relatively small values of gradients due to noise and small differences in the brightness of objects are suppressed. At this stage, using two threshold values of the gradients, the selection of "strong" and "weak" edges is performed.

The last step of the Canny detector is edge connectivity analysis, which involves removing "weak" edges that are not connected to "strong" edge points. The resulting binary image is then subjected to contour analysis, which involves searching for all closed contours, calculating their areas and selecting the contour with the largest area that corresponds to the contours of the document.

For a visual assessment of the correctness of the found contour, the inner part of the contour is then filled with the initial pixel brightness values. The result of searching for document contours in accordance with the proposed algorithm is shown in Fig.3.



Fig. 3 — Result of detection of document contours Conclusions

The proposed paper documents contours detection algorithm can be used as part of more complex algorithm solving the task of creating scannerquality documents copies based on their photographs.

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UDC 51.004

CHANGED IMAGE PERSPECTIVE TRANSFORM

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Аннотация. В статье рассматривается алгоритм измененного преобразования перспективы изображения. Проведен анализ алгоритмов аффинных преобразований перспективы изображения. Приводятся блок-схема алгоритма и промежуточные результаты работы алгоритма. На основе проведенного анализа делается вывод, что предложенное преобразование перспективы изображения может использоваться в качестве мобильного приложения – сканера, способное заменить стационарный сканер в случае невозможности доступа к нему.

Ключевые слова: сканер, алгоритм, аффинное преобразование, перспектива изображения, OpenCV.

Annotation. The article uses an algorithm for transforming the appearance of an image. The analysis of algorithms for affine transformations of perspective images has been carried out. When using the block diagram of the algorithm and the intermediate results of the algorithm. Based on the analysis, it is concluded that the proposed image transformation can be implemented as a mobile application - a scanner that can replace a stationary scanner if it is impossible to access it.

Keywords: scanner, algorithm, affine transformation, image perspective, Open CV.

Introduction

Affine and perspective transformations of images are now widely used in computer graphics and image processing. They change the geometric structure of an image while maintaining line parallelism, collinarity, and distance relationships.

Most often, algorithms using geometric transformations include the stage of searching for an object of interest in a separate image that has the desired shape, a certain area size or number of corners. To perform an affine transformation, you must specify two sets of coordinates of three points corresponding to the original and transformed position of the plane. Sets of four points are used to perform perspective transformation. However, in order to perform a geometric transformation of an image of an object of complex shape located in space in different planes, it is necessary to be able to transform regions of interest that have a larger number of vertices.

The paper proposes an algorithm for the modified image perspective transformation, which is applicable to create a similarity of a scanned copy of documents from their photographs.

Main part

Perspective transformation is performed using the following expression:

$$\begin{bmatrix} x'\\y'\\1 \end{bmatrix} = \begin{bmatrix} a & b & c\\d & e & f\\g & h & 1 \end{bmatrix} \begin{bmatrix} u'\\v'\\1 \end{bmatrix},$$

Where x', y' - abscissa and ordinate of the transformed image;

u', *v*'– abscissa and ordinate of the original image;

a, *b*, *d*, *e* – control scaling, cropping and image rotation;

g, h – control the movement of the image;

c, f – control the perspective transformation of the image.

The result of transforming the perspective of the document in the image is shown in fig. 1.



Fig. 1. – The result of the program

To correct the roughness of the paper of a document, it is proposed to use not four, but eight or more sets of coordinates of points that define the outline of the document when performing a perspective transformation.

The modified perspective transformation is performed in two steps:

1) the initial data for the first perspective transformation is the image containing the outline of the document with four corners, having the largest area;

2) arbitrary contour coordinates are translated into the corresponding rectangle coordinates of the given size; after that, the coordinates of the four deepest contour irregularities on each side of the sheet are found on the resulting image, which are used further for the second perspective transformation.

The block diagram of the proposed algorithm is shown in fig. 2. Software implementation is done using the development environment Microsoft Visual Studio C++ and computer vision libraryOpenCV v.4.6.0.



Fig. 2— Block diagram of the algorithm

Conclusions

An algorithm of modified image perspective transformation, which involves the use of a two-stage transformation using eight sets of document outline coordinates, is proposed. The block diagram of the algorithm is given.

In further studies, it is planned to use this algorithm to create a mobile application that is minimally inferior to conventional desktop scanners in terms of scan copy quality.

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FLARE VM FOR MALWARE ANALYSIS

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Аннотация. В статье представлено подробное руководство по FlareVM, инструменту, используемому для анализа вредоносных программ. В нем подчеркивается важность FlareVM для безопасного обнаружения вредоносного программного обеспечения и объясняются особенности И преимущества его использования лля анализа программ. В руководстве содержатся подробные вредоносных инструкции по установке виртуальной машины Flare, системным требованиям и устранению распространенных проблем при установке. В нем также описывается, как настроить и использовать FlareVM для анализа вредоносных программ, включая установку и настройку общих инструментов. В статье также подчеркивается важность технического обслуживания, включая обновление виртуальной машины Flare и настройку резервного копирования и восстановления. В целом, статья представляет собой информационный ресурс для всех, кто заинтересован в использовании FlareVM для анализа вредоносных программ.

Ключевые слова: FlareVM, Анализ вредоносных программ, Обратное проектирование, Системные требования, Техническое обслуживание.

Annotation. The article provides a comprehensive guide to Flare VM, a tool used for analyzing malware. It highlights the importance of Flare VM in detecting malicious software safely and explains the features and advantages of using it for malware analysis. The guide provides detailed instructions on installing Flare VM, system requirements, and resolving common installation issues. It also outlines how to configure and use Flare VM for malware analysis, including installing and configuring common tools. The article also highlights the importance of maintenance, including updating Flare VM and setting up backup and recovery. Overall, the article is an informative resource for anyone interested in using Flare VM for malware analysis.

Keywords: FlareVM, Malware analysis, Reverse engineering, System requirements, Maintenance.

I. Introduction

Flare VM is a powerful tool that cybersecurity researchers and analysts use for malware analysis. Flare VM is a virtual machine designed for reverse engineering, malware analysis, debugging and forensics. As the world becomes more digitally dependent, the threat of malware increases every day. That's why it's important to have efficient malware analysis tools like Flare VM. With Flare VM, analysts can easily isolate samples, dissect malware, identify signatures, and understand the inner workings of complex malware. It is an essential tool for anyone who works with malware analysis.

II. Flare VM Overview

Flare VM is a virtual machine that has been specifically designed to provide a safe, isolated environment for conducting malware analysis, reverse engineering, debugging, and forensics. The aim of Flare VM is to make the malware analysis process as efficient, reliable and secure as possible by providing pre-configured software, tools, and a virtual environment for the analyst.Flare VM is based on the Windows operating system, and it comes equipped with several tools and software packages used in malware analysis, such as IDA Pro, Wireshark, and Fiddler. Flare VM is also fully customizable, allowing analysts to add or remove software, as per their analysis needs.

One of the key features of Flare VM is its powerful command-line interface, which provides the analyst with complete control over the virtual machine environment. Analysts can configure the virtual machine to their liking, save their changes, and then easily replicate the environment for future analysis.Another feature of Flare VM is its pre-configured environment that provides the analyst with a fully-functional Windows environment. This eliminates the need to install and configure any software and tools, and allows the analyst to start analyzing malware right away.

The primary advantage of using Flare VM is its ability to provide a safe and isolated environment for malware analysis. Running malicious software on a traditional system risks infecting other parts of the machine and potentially disrupting critical operations. Flare VM eliminates this risk by creating a boundary between the virtualized environment and the host machine and providing an isolated environment for analysis.Additionally, Flare VM is easily customizable, as analysts can swiftly add, remove or update software and tools as the needs of the analysis change. This customization eliminates the manual setup time that would be required to get a virtual machine up and running for malware analysis. The result is a streamlined malware analysis process that saves time and provides a secure environment.

III. Installing Flare VM

To install Flare VM, you can download it from the official website and extract the downloaded files. After opening VMware Workstation Player or Pro, you should select "Open a Virtual Machine." Select the .vmx file from the extracted files, review the virtual machine settings, and adjust them as per your specific requirements. Power on the virtual machine to complete the installation process. If you face installation issues such as "Error launching Flare VM", it may be because of incorrect virtual machine settings. You should ensure that you've configured the virtual machine correctly and allocated sufficient resources. If you face a network connection issue, check that the virtual network adapter is set to the correct mode. If you encounter performance issues, increase the number of CPU and memory resources allocated to the virtual machine.

After installing Flare VM, you should configure the virtual machine to your specific needs. Once you finish configuring, you can begin using the tool for various malware analysis activities.

IV. Getting Started with Flare VM

Flare VM simplifies malware analysis by providing an isolated, secure environment for researchers and analysts. After installing Flare VM, the first step is to configure the virtual machine to meet your specific needs. This could involve alterations to the configuration of the virtual machine or the installation of software and tools necessary for malware analysis.Common tools used in malware analysis can be installed and configured on Flare VM. Examples include Windbg, Ghidra, IDA Pro, Wireshark, Cuckoo, and Any.Run. Installing these tools ensures that you have everything you need to perform malware analysis activities with greater ease.

Flare VM can be used for malware analysis activities, such as reverse engineering, debugging or disassembling the malware executable. The safe and isolated environment minimizes the risk of malware infections or impact on the host machine. You can monitor network activity, identify communications with control and command servers, and perform a deep analysis of the malware using Flare VM. It is an indispensable tool for malware analysis, enabling reliable and efficient reverse engineering, debugging, and forensics. Its flexibility and ease of use make it a popular choice among cybersecurity researchers and analysts. By configuring the virtual machine to meet your specific needs, installing required tools, and using Flare VM for malware analysis activities, you can enhance your cybersecurity analysis capabilities.

V. Flare VM Maintenance

As a virtual machine environment, Flare VM must be frequently maintained to ensure that it runs efficiently and accurately. This section discusses the aspects of maintaining Flare VM, including updating it, configuring backup and recovery, and common issues that occur during maintenance and how to fix them.

It is crucial to keep Flare VM up to date with the latest software updates and patches to make sure it is secure and stable. To update Flare VM, you can download the latest package from the official website and install it over the existing installation. After that, you need to ensure the current configuration and software requirements are being met.Configuring backup and recovery of Flare VM ensures that your environment is well-protected in case of any disaster or failure. It is essential to have a backup of your virtual machine image and make sure it is stored securely. With frequent backups, you can recover your environment in the event of data loss or a malware infection [3].

One of the most common issues during maintenance is networking problems. If you face a network issue, check and verify the settings to make sure you can connect to the network. Another issue with Flare VM is performance degradation. To fix this, allocate more CPU and memory resources to the virtual machine. Furthermore, if you experience any software malfunctions or crashes, you can repair or reinstall the software to fix the issue [1].

In general, maintaining Flare VM involves updating it with the latest software updates to keep it stable and secure, configuring backup and

recovery to ensure the environment is well-protected, and resolving common problems that may arise during the maintenance process. Proper maintenance ensures Flare VM runs efficiently and accurately, providing you with a reliable and consistent workspace for successful malware analysis [2]. By frequently backing up and updating Flare VM, you can prevent data loss and maintain a stable environment for unreliable malware analysis operations.

VI. Conclusion

In conclusion, one should note that Flare VM is a powerful and popular tool for malware analysis that provides a safe and isolated environment to execute malware and analyze its behavior. It simplifies the malware analysis process by providing pre-installed software packages, tools, and features necessary for in-depth malware analysis. Flare VM's numerous benefits include customizability, ease of use, and low risk of infections on the host system.

The primary benefits of using Flare VM for malware analysis are its flexibility, safety, and ease of use. With Flare VM, cybersecurity professionals can quickly dive into analyzing malware without having to worry about infection reaching other parts of the system. By providing built-in tools and features, Flare VM enables efficient customization of the malware analysis environment according to specific analysis needs.

It is clear, that Flare VM is an essential tool for malware analysis, providing a reliable environment for researchers and analysts to reverse engineer, debug and forensically analyze malware. Its ability to provide a safe, isolated environment for malware analysis while preventing infections and security breaches make it an indispensable tool for the cybersecurity realm.

Finally, Flare VM is an asset to the malware analysis community. The ability to create customized environments, easily install and use malware analysis tools, and automate repetitive tasks makes it a powerful tool for cybersecurity professionals.

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THE IMPORTANCE OF MALWARE ANALYSIS SANDBOXES IN CYBERSECURITY

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Аннотация. В статье рассматриваются "песочницы" для анализа вредоносных программ и их значения в защите систем и данных от киберугроз. Во введении даются определения "песочниц" для анализа вредоносных программ и подчеркивается ИХ важность лля кибербезопасности. Затем в статье рассматриваются различные типы изолированных сред анализа вредоносных программ, включая статические, динамические и гибридные изолированные среды анализа, и объясняются преимущества их использования. Кроме того, в статье ключевые особенности "песочниц" освещаются лля анализа вредоносных программ, такие как масштабируемость, настройка и интеграция с другими инструментами безопасности. В статье также перечислены популярные песочницы для анализа вредоносных программ, включая Cuckoo Sandbox, Hybrid Analysis и VirusTotal.

Ключевые слова: вредоносные программы, Кибербезопасность, песочницы, Анализ, Киберугрозы

Annotation. The article provides a comprehensive overview of malware analysis sandboxes and their significance in protecting systems and data from cyber threats. The introduction provides definitions of malware analysis sandboxes and underscores their importance in cybersecurity. The article then delves into the different types of malware analysis sandboxes, including static, dynamic, and hybrid analysis sandboxes, and explains the benefits of their use. Additionally, the article highlights key features of malware analysis sandboxes, such as scalability, customization, and integration with other security tools. The article also lists popular malware analysis sandboxes, including *Cuckoo Sandbox*, *Hybrid Analysis*, and *VirusTotal*.

Keywords. Malware, Cybersecurity, Sandboxes, Analysis, Cyberthreats

I. Introduction

Malware analysis sandboxes are controlled environments in which cybersecurity professionals can safely execute various types of malware to analyze their behavior and identify potential threats. These sandboxes are designed to simulate real-world computer systems while protecting the host system from potential infection or damage by the malware being analyzed. This allows cybersecurity experts to identify potential security vulnerabilities and develop more effective defenses against cyberattacks.

In today's interconnected world where cyberattacks are becoming increasingly sophisticated, malware analysis is critical to cybersecurity. Malware is a term that is used to describe any harmful software or program that is designed to disrupt, damage or gain unauthorized access to a computer system, network, or device. Malware can be used to steal sensitive data, gain unauthorized access, cause system failure or even sabotage a company's reputation [2].

Malware analysis plays a crucial role in cybersecurity as it helps to identify and understand the capabilities of different malware strains. This, in turn, allows cybersecurity professionals to develop effective countermeasures to protect organizations from potential attacks. In addition, malware analysis helps to enhance threat intelligence and identify emerging trends, which can help organizations stay ahead of potential threats [1].

II. Types of Malware Analysis Sandboxes

There are three different techniques cybersecurity professionals use to analyze and identify potential threats in the form of malicious software: static, dynamic, and hybrid malware analysis. These techniques have varying levels of complexity and specificity, and they provide a range of benefits and drawbacks to analysts depending on the type of malware sample in question [4].

Static malware analysis is the process of examining a malware sample without executing it, allowing the analyst to gain insights into its inner workings without potentially damaging the environment in which the sample is being analyzed. Specifically, static analysis often involves the use of reverse engineering software to examine the code of the malware and determine its various capabilities and potential risks. Static analysis can be fast, efficient, and relatively safe, making it a popular choice for initial scans of malware samples.

Dynamic malware analysis, in contrast, involves the execution of a malware sample in a controlled, sandboxed environment to observe and analyze its behavior. Dynamic analysis can provide rich insights into how a malware sample interacts with a system, including the files it accesses, processes it starts, and network traffic it generates. Dynamic analysis is more complex than static analysis, as it requires extensive systems engineering skills to simulate the targeted environment under which the malware would sprout. However, in exchange, it can provide more useful findings, such as indications of where the malware author could attack next. Hybrid malware analysis involves a combination of static and dynamic analysis. Hybrid analysis can use the strengths of both static and dynamic analysis techniques to more accurately determine the characteristics of a malware sample [3]. For example, the analyst could first examine the sample using static analysis to determine its overall structure and intended function. The analyst could then use dynamic analysis techniques to observe the influenced system as the malware is executed in the environment, with all probes and sensors set up to collect information on memory, network behavior and runtime evaluation. Through this, the analyst can merge static analysis outputs such as known call flow data to enhance the data learned during the dynamic analysis process.

III. Benefits of Malware Analysis Sandboxes

Malware analysis sandboxes are essential tools in the fight against cyber threats, providing safe environments in which organizations can analyze, detect and mitigate malware. The main benefits of using malware analysis sandboxes include the ability to safely execute malware samples, improved detection rates of malware, enhanced network security, and better collaboration among cybersecurity professionals.

By allowing malware to run safely in controlled environments, malware analysis sandboxes help cybersecurity professionals identify threats that may have gone undetected through traditional detection technologies. Furthermore, malware analysis sandboxes are essential for developing more effective countermeasures against new threats by understanding their behavior and intended function.

In addition, malware analysis sandboxes help automate the process of detecting and analyzing malware samples, improving efficiency, and reducing response times. This enables organizations to respond proactively to emerging threats, minimize downtime, and maximize system security.

Malware analysis sandboxes promote better collaboration among cybersecurity teams, enabling knowledge-sharing and enhanced trend analysis. It allows teams to share data on emerging threats, analysis results, and overall security enhancements, all of which can help prevent future malware attacks.

Overall, malware analysis sandboxes are critical to ensuring the security and integrity of an organization's systems and data. By providing a safe and collaborative environment, improved security, enhanced detection ability, and efficient analysis solutions, malware analysis sandboxes are essential in mitigating against cyber threats and safeguarding against potential data breaches.

IV. Key Features of Malware Analysis Sandboxes

Malware analysis sandboxes are an essential tool for organizations to detect, analyze and mitigate malware threats securely. To achieve their objectives, these sandboxes should have several critical features.

One essential feature is customization, where the environment is tailored to a specific threat, increasing accuracy and improving detection rates. Another important feature is integration with other security tools. These tools aid in the process of malware analysis, making it more efficient and accurate.

Virtualization allows malware to be analyzed in an isolated environment, enhancing security in the analysis process. Network monitoring capabilities enable the detection and analysis of network traffic generated by malware, providing critical insights. Automated analysis tools are essential in identifying potential risks in quickly detecting malware. Reporting and analysis output capabilities inform all stakeholders of the analysis findings, reducing further network downtime and increasing protection against cyber threats.

Overall, malware analysis sandboxes should have several critical features to offer maximum protection against cyber threats. These features include customization, integration, virtualization, network monitoring, automated analysis, and reporting. Employing a secure environment using these features can help organizations swiftly detect and mitigate any cybersecurity threats effectively.

V. Popular Malware Analysis Sandboxes

There are several popular malware analysis sandboxes used in cybersecurity, each with their unique features and capabilities. The *Cuckoo Sandbox*, an open-source platform, is widely used for its scalability, customization, and integration features. *VirusTotal* is a fast and accurate online service that can detect malware and provide detailed analysis results. Hybrid Analysis offers both static and dynamic analysis capabilities and allows for the creation of dynamic signatures that protect against similar attacks. *Any.Run* offers real-time dynamic analysis and easily customizable reports. Lastly, *Sandboxie* provides a secure environment for malware analysis by isolating applications and files from the operating system.

VI. Best Practices for Malware Analysis Sandboxes

To ensure that malware analysis sandboxes are effective in detecting and mitigating malware, organizations must follow best practices. These practices include keeping the sandbox software, analysis tools, and detection capabilities up-to-date. A malware analysis sandbox environment must also be secured and isolated to prevent harmful effects on the network or systems in use. Access controls and firewalls are necessary to achieve sandbox security. Regularly analyzing sandbox data and sharing analysis results with the broader security community to boost security is vital. This includes sharing vulnerabilities, weak spots, attack trends, and new threats. By sharing this information with the security community, organizations can promote safer digital experiences.

VII. Conclusion

In conclusion, the use of malware analysis sandboxes is crucial in the field of cybersecurity. These sandboxes play a significant role in identifying and analyzing malicious software, providing valuable insights into potential threats and vulnerabilities. Additionally, the continuous development and improvements in malware analysis technology ensure that the sandboxes remain effective and relevant tools in combating cyber threats. As the threat landscape continues to evolve, it is important for organizations to stay vigilant and adopt the latest malware analysis technologies to protect their systems and data. Investment in malware analysis sandboxes and related technologies is a wise decision for any organization that values cybersecurity.

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SETTING UP YOUR OWN MALWARE ANALYSIS LAB

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Аннотация. В этой статье объясняется природа и значение анализа вредоносных программ, а также как создать специальную лабораторию анализа вредоносных программ. В нем рассматриваются различные типы анализа вредоносных программ, их автоматизация и интеграция как важнейшие компоненты процесса создания лаборатории вредоносных программ. В статье описываются требования к оборудованию и программному обеспечению, необходимые для успешного анализа вредоносных программ, и предлагается обзор различных инструментов анализа вредоносных программ. В нем также проведение обсуждается анализа вредоносных программ И реагирование на результаты. Решаются проблемы безопасности и технического обслуживания с уделением особого внимания передовым методам аварийного восстановления и технического обслуживания.

Ключевые слова: Анализ вредоносных программ, Кибербезопасность, Автоматизированные инструменты, Восстановление системы, Настройка сети.

Annotation. This article explains the nature and significance of malware analysis, and how to set up a dedicated malware analysis lab. It explores different types of malware analysis, automation, and integration as essential components of the malware laboratory process. The article outlines the hardware and software requirements needed for successful malware analysis, and offers an overview of various malware analysis tools. It also discusses conducting malware analysis and responding to the results. Security and maintenance concerns are addressed, with a focus on disaster recovery and upkeep best practices.

Keywords: Malware Analysis, Cyber Security, Automated Tools, System Recovery, Network Configuration.

I. Introduction

Malware analysis is the process of detecting and analyzing malicious software to identify potential security threats. With the increasing prevalence of malware attacks, it has become imperative to have a dedicated malware analysis lab to help organizations quickly identify and mitigate these threats. A malware analysis lab enables analysts to examine malware specimens in a controlled environment, allowing them to better understand and improve their strategies for defending against cybersecurity breaches. In this guide, we will explore the importance of setting up a dedicated malware analysis lab and discuss effective strategies for implementation.

II. Understanding Malware Analysis

Malware analysis involves different types of analysis such as static, dynamic, and hybrid. Static analysis involves examining the code, structure, and metadata of a malware specimen without executing it. Dynamic analysis involves executing the malware in a controlled environment to observe its behavior, while hybrid analysis combines both static and dynamic analysis techniques. Automated malware analysis has become increasingly important due to the high volume of malware samples and the need for quick and efficient analysis. Automated malware analysis enables analysis to sift through large volumes of malware samples, reducing the time and resources required for analysis. Malware analysis tools are essential for analyzing malware specimens. These tools include threat intelligence platforms, malware sandboxes, de-obfuscators, and debuggers. Malware analysis tools are constantly evolving and adapting to new threats, making them vital for detecting and mitigating security threats.

III. Setting up the Malware Analysis Lab

Setting up a malware analysis lab requires careful planning and adherence to best practices to ensure accuracy and security. To effectively analyze malware, the lab must have robust hardware and software. At a minimum, the system used for the malware analysis should have high-speed processors, a minimum of 16GB RAM, and a large storage capacity. The system should also be equipped with virtualization technology to enable the creation and management of virtual environments to safely analyze malware. A reliable backup and recovery system should be in place to allow for quick recovery of important data in the event of any system failure.

Selecting the right operating system and software is crucial for setting up a successful malware analysis lab. The operating system selected should support the necessary software packages and tools required for the analysis. Microsoft Windows is the most popular choice, but Linux and macOS are also used in specialized environments.

To analyze malware samples, a suite of software tools, such as malware analysis sandboxes, dynamic analysis tools, disassemblers, unpackers, and debuggers is required. Open-source and commercially available tools are available for malware analysis. Popular tools for malware analysis include IDA Pro, OllyDBG, Ghidra, Wireshark, and VirusTotal.The malware analysis lab network must be isolated to prevent accidental or intentional propagation of malware. Configuring a secure network requires a high level of knowledge of network security. The use of firewalls, intrusion detection systems, and virtual private networks (VPNs) is recommended in setting up a secured network environment for malware analysis.

In addition, it is important to ensure that all software and hardware components of the malware analysis lab are kept up-to-date with the latest security patches and updates to prevent vulnerabilities and attacks [2].

IV. Malware Analysis Tools

Dynamic analysis tools such as IDA Pro, OllyDBG, and Ghidra, together with sandbox analyzers, unpackers, and debuggers, are some common tools used for malware analysis. YARA, VirusTotal, and Suricata are also used in identifying and detecting malware. The process of installing these tools may vary depending on the tool and the operating system of the analysis lab. However, it is essential to update the tools to the most recent version and configure them to work optimally in the environment for which

they were installed. After installation and configuration, it is vital to test and validate the tools to ensure that they perform as intended. Testing involves analyzing a sample of clean code to ensure that the tool can detect, identify, and classify them accurately. Validation involves benchmarking the tool's performance against metrics or standards to confirm that it meets the required standards.

V. Automation and Integration

Automation is an essential element of any successful malware analysis lab. By introducing automated tools into the lab, analysts increase efficiency by streamlining the process of malware analysis. Automated tools reduce the time and resources required to analyze large volumes of malware specimens while also improving the overall accuracy of the analysis. The benefits of automation in malware analysis include increased efficiency, low error rates, and the ability to analyze large volumes of malware samples in a short time. This increases the number of samples that can be analyzed, thus providing valuable insights that would be otherwise challenging to achieve through manual analysis [3].

Integrating automated tools with the malware analysis lab involves the combination of different automated tools to achieve a comprehensive and accurate malware analysis. This entails the use of APIs, software application wrappers, and other mechanisms to interconnect the tools. It further helps to standardize the analysis process, thus improving the workflow and facilitating the quick identification and mitigation of security threats [1].

VI. Conducting Malware Analysis

When it comes to malware analysis, there are several essential steps that must be taken to ensure success. One of the first steps is to collect malware samples. These samples can come from a variety of sources, such as emails, websites, or even USB drives. Once you have a sample, it is important to determine what type of malware it is, and what action it might take on the system. This is where different types of malware analysis come into play.

One type of malware analysis is dynamic analysis. This involves running the malware in a controlled environment to observe its behavior. Another type of analysis is static analysis, which involves examining the actual code of the malware. Both of these methods can provide valuable insights into the malware's function and potential impact.

After conducting these analyses, it is important to store and document the results. This not only allows for future reference, but it can also be important for legal or forensic purposes. Storing the results securely is also vital to prevent any potential leaks or breaches.

Overall, conducting malware analysis requires a careful and thorough approach. By collecting malware samples, applying different types of analysis, and storing and documenting the results, you can be better equipped to detect and prevent malware threats.

VIII. Conclusion

In conclusion, this article highlights the significance of malware analysis labs in the current digital age. As we witness a steady rise in malware attacks, it is essential to have dedicated labs that can analyze any new or suspicious software and prevent security breaches. By providing a comprehensive overview of what a malware analysis lab is and what it entails, this article serves as an eye-opener to many businesses and organizations that overlook the importance of such security measures.

Malware analysis labs play a critical role in identifying the source, the behavior, and potential effects of malicious software. They help businesses stay informed and make timely decisions to prevent further damage. By conducting a thorough analysis, these labs can inform IT staff about the nature and goals of a particular malware strain, allowing them to develop more effective prevention strategies.

In addition to providing IT staff with valuable information, malware analysis labs are also beneficial for law enforcement officials investigating cybercrimes. The results of analysis can be presented as evidence in court, contributing to the prosecution of cybercriminals.

The importance of having a dedicated malware analysis lab cannot be overstated. Cybercriminals continue to use more sophisticated and elusive methods of infecting systems, and companies need to stay ahead of the curve. Investing in a lab that can efficiently analyze malware will save them a lot of time and resources in the long run.

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EXPLORINGTHEAPPLICATIONOFDEEPLEARNINGMETHO DSFORTEXTTONERECOGNITIONIN SOCIALNETWORKS Vladislav Tatarinov

2ndyearstudent,TheInstituteofInformationTechnology, Sevastopol State University,e-mail:ducknuk.em13@gmail.ru Sergey Minkin Scientific advisor,Assistantprofessor, Аннотация. Данная статья посвящена исследованию возможности применения методов глубокого обучения дляраспознаваниятональноститекставсоциальныхсетях. Авторрассматр иваетпроблемуклассификациитекстовых сообщенийнапозитивные, негат ивныеинейтральныевконтекстесоциальныхсетей, гдеобработкаианализ большого объема данных становитсявсеболееважнойзадачей.

Встатьеописываетсяметодикаисследования,котораявключаетвсебя предобработкуданных,выбориобучениемоделиглубокогообучения,атак жеоценкукачестваработымодели.Авторпредлагаетиспользовать сверточные нейронные сети и рекуррентные нейронные сети для анализа текстовых данных, атакже применятьразличные

методыпредобработкиданных, такие каклемматизацияиудалениестопслов.

В результате исследования автор приходит к выводу о том, что методы глубокого обучения могутбыть успешно применены для классификации тональности текстовых сообщений в социальных сетях. Приэтомвыборконкретноймоделииметодовпредобработкиданныхзавис итотконкретнойзадачиихарактеристикдатасета.

Ключевые слова: глубокое обучение, распознавание тональности, текстовые данные, социальные сети, сверточные нейронные сети, предобработка данных, лемматизация, стоп-слова.

Annotation. This paper explores the possibility of using deep learning methods to recognize the tone of text in socialnetworks. The author considers the problem of classifying text messages into positive, negative and neutral in the context of social networks, where the processing and analysis of large amounts of data is becoming an increasinglyimportanttask.

Thepaperdescribestheresearchmethodology,whichincludespreprocessin gthedata,selectingandtrainingadeeplearningmodel,andevaluatingthequalityof themodel'sperformance.Theauthorproposestouseconvolutional neural networks and recurrent neural networks to analyze textual data, as well as to apply variousmethodsofdata preprocessing, such aslemmatizationandstopwordremoval.

As a result of the study, the author concludes that deep learning methods can be successfully applied toclassify the tone of text messages in social networks. The choice of a particular model and preprocessing methodsdependsonthe specific task and characteristics of the dataset.

Keywords:deeplearning,tonerecognition,textualdata,socialnetworks,co nvolutionalneuralnetworks,recurrentneuralnetworks, preprocessingdata,lemmatization,stopwords.

Introduction

Importanceofanalyzing thetoneoftextmessagesinsocialnetworks

Inrecentyears, social networks have become apopular platform for peopleto share their thoughts, opinions, and experiences with others. As a result, social media platforms generate a massive amount of textual data that can provide valuable insights into people's attitudes and behaviors. Analyzing thet one of text messages insocial networks can be particularly useful for businesses and organizations to understand their customers' sentiments towards their products or services [3, 6]. It can also help policy makers to identify public opinion on social and political issues.

Briefoverviewofthepaper'spurposeandmethodology

This paper explores the potential of deep learning methods to recognize the tone of text in social networks.Specifically,thepaperdiscussestheproblemofclassifyingtextmessag esintopositive, negative, and neutral tones in the context of social networks. The pa perpresents are search methodology that involves data preprocessing, selecting an d training a deep learning model, and evaluating the quality of the model's performance. The author proposes theuse of convolutional neural networks [10] and recurrent neural networks [11] for analyzing textual data and suggestsapplying various methods of data preprocessing, such as lemmatization and stop-word removal. The paper concludes that deep learning methods can be successfully applied to classify the tone of text messages in social networks, andthe choice of a particular model and preprocessing methods depends on the specific task and characteristics of thedataset.

PreprocessingtheData

A. Descriptionofdatapreprocessing

Datapreprocessingisanessentialstepinsentimentanalysisthatinvolvesclea ningandtransformingrawtextdata into a structured format that can be easily processed by machine learning algorithms [1, 7]. Preprocessing stepscommonlyusedinsentimentanalysisincluderemovingstopwords, stemmin gorlemmatizingwords, and converting text to lowercase [5, 8]. Removing irrelevant or redundant information from the text can help to improve theperformanceofsentimentanalysismodelsbyreducingnoiseand improving the accuracy of sentiment predictions.

B. Useoflemmatizationandstop-wordremoval

Twocommonpreprocessingtechniquesusedinsentimentanalysisarelemm atizationandstop-wordremoval.Lemmatization is the process of reducing words to their base or dictionary form, while stop-word removal involvesremovingcommonlyusedwordsthatdonotcarrymuchmeaning,suchas" the, ""and, "or"a"[2, 9].Thesetechniquescan help tosimplify textdata,reduce itscomplexity, and improve the accuracy of sentimentanalysismodels.

C. Advantagesofpreprocessing

Data preprocessing is critical to achieving accurate and reliable results in sentiment analysis tasks [4, 13].By reducing noise and removing irrelevant information from text data, preprocessing techniques can help to improve the performance of sentiment analysis models and reduce computational requirements. Furthermore, data preprocessing can be used to address issues related to class imbalance, data sparsity, and domain adaptation, which are common challenges in sentiment analysis tasks [12].

SelectingandTraininga DeepLearningModel

A. Overviewofdeep learning models

Deep learning models are a class of machine learning algorithms that use multiple layers of artificial neuralnetworks to learn hierarchical representations of data. These models have been widely used in naturallanguage processing tasks, including sentiment analysis, due to their ability to capture complex patterns in text data. Popular deep learning models for sentiment analysis include convolutional neural networks (CNNs),recurrentneuralnetworks(RNNs), and theirvariants, such aslong short-term memory (LSTM) networks.

B. Traininga deeplearningmodel

To train a deep learning model for sentiment analysis, the text data must first be transformed into numerical representations, such as vectors or matrices. This can be achieved using various techniques, such as word embedding or bag-of-words representation. Once the data is transformed, it can be used to train a deep learning model using a suitable optimization algorithm, such as stochastic gradient descent (SGD) or Adam. The model's performance can be evaluated using various metrics, such as accuracy, precision, recall, and F1-score.

Evaluating the quality of the model's performance

The quality of a deep learning model's performance in sentiment analysis tasks can be evaluated using various techniques, such as crossvalidation, test sets, and confusion matrices. Cross-validation involves partitioning the data into multiple subsets and using each subset as both trainingandtestdatatoevaluatethemodel'sperformance.Test sets involve partitioning the data into separate training and test sets and using the test set to evaluate the model'sperformance. Confusion matrices provide a more detailed evaluation of the model's performance by showing thenumberof true positives, truenegatives, falsepositives, andfalsenegatives.

EvaluatingModelPerformance

A. Metricsusedto evaluatemodelperformance

The metric sused to evaluate the performance of sentimentanaly sismodels in clude precision, recall, F1 score, and accuracy. These metrics can be used to assess here the sentence of the se
ow well the model performs in classifying positive, negative, and neutral sentiment

B. Analysisoftheresults

Theanalysisofthemodel'sresultsinvolvesexaminingtheconfusionmatrixt odeterminethenumberoftruepositives,truenegatives,falsepositives,andfalsene gatives.Additionally,visualizingtheresultscanprovideinsightsinto the strengthsandweaknessesofthe model.

C. Discussionofthemodel'saccuracy

Theaccuracyofthesentimentanalysismodelisinfluencedbyvariousfactors ,includingthesizeandqualityof the dataset, the choice of model architecture, and the preprocessing techniques used. A discussion of the model'saccuracy shouldconsider these factors and how they impact the performance of the model.

Conclusion:

This paper explores the potential of using deep learning techniques to classify the tone of text in socialnetworks as positive, negative, or neutral. The research methodology involves preprocessing the data, selecting andtrainingadeeplearningmodel, and evaluating the quality of the model's performance. Two types of neural networks, convolutional and recurrent,

areproposed for analyzing the textual data, along with various methods of datapreprocessing. The study concludes that deep learning methods can successfully classify the tone of text messages insocial networks, with the choice of model and preprocessing methods depending on the task and dataset. The paper provides an overview of the metrics used to evaluate model performance, analysis of the research methodology and findings, discusses the future implications and directions for research, and highlights some of the limitations and challenges associated with using deeplearning for tone classification.

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HYBRID ANALOG AND DIGITAL BEAMFORMING FOR MIMO 5G SYSTEMS

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Аннотация. В статье рассмотрена реализация гибридного формирования и управления лучами диаграммы направленности, сочетающий в себе как цифровые, так и аналоговые методы для формирования многолучевой диаграммы направленности.

Предложена модель гибридной радиофотонной системы передкодирования, с низким уровнем потерь в РЧ тракте и минимальными помехами между абонентами, при цифровом формировании луча. В отличие от классических РЧ гибридных систем предварительного кодирования, Радиофотонные гибридные системы предварительного кодирования могут обеспечивать более высокие скорости передачи данных и меньшую частоту ошибок в сценариях многопользовательской передачи.

Ключевые слова: формирование луча ДН, 5G, многолучевая антенная решетка.

Annotation. Proposed a photonic hybrid precoding model for mmwave radio-over-fiber systems that overcomes hardware constraints on radio frequency precoding. With the help of analog photonic beamformers, the hybrid precoding strategy combats the large losses of mm-wave and mitigates inter-user interference, which in turn reduces the number of RF chains required to perform digital beamforming. Unlike RF hybrid precoding systems, the photonic hybrid precoding systems can provide higher data rates and lower error rates in multi-user transmission scenarios.

Keywords: beamforming, 5G, multipath antenna array.

Introduction.

Beamforming is an important broadcast method that involves use of antenna arrays in a mobile system to organize wireless channels along the specific directions. How it is implemented is a matter of great interest for RF industry due to the conflicting requirements of efficiency and flexibility.

The key structure needed to perform beamforming is an antenna array. By controlling the relative phases and amplitudes of the signals sent to the phased array can control the direction of the emitted beam. The number of possible beams that can be emitted can be further doubled by exploiting orthogonal polarization, or by only emitting electromagnetic radiation along one direction from each emitter in the array [1].

Main part.

Analog beamforming operates by sending a signal to multiple antennas in an antenna array. The signals sent to each antenna are delayed by a specific time window, which applies a phase difference to the emission emitted from other antennas in phased arrays. A simplified analog beamforming framework is shown in the figure. The weights are adaptively computed in digital domain and updated in analog domain using specific DSP algorithms for a target criterion.

On the Tx side, the baseband signal is generated in the digital domain that is converted into an analog signal through a Digital-to-Analog Converter (DAC), up-converted to a higher carrier frequency (e.g., 28 GHz) and then fed to an analog beamforming network through a splitter. Here, the weights are applied through several digitally controlled phase shifters, one per antenna element. Analog beamforming is power and cost efficient as it has only one pair of ADC, DAC and a single RF chain. However, it comes at a cost of following drawbacks:

— It is difficult to implement advanced beamforming techniques such as creating nulls in specific directions during transmit or receive. This can create significant interference among undesired directions.

— Fine tuning of the beams is limited due to the low resolution of quantized phase shifts.

— From the figure above, it is difficult to support multiple streams for multiuser MIMO. In general, a phase shifted version of the same signal is sent from all the antennas into a particular direction.

— RF phase shifters suffer from performance degradations due to losses and distortions.

All these challenges are easier to overcome through a digital beamformer.

Digital beam shaping uses a less intuitive approach. In digital beamforming, multiple modulated signals are sent to the antenna array, and the phases and amplitudes of the signals sent to the array are combined to produce the desired beam pattern. The most basic case uses a single input data stream (such as QAM constellation points) sent to multiple antennas, and the amplitudes are combined to produce the desired emission pattern.

Digital beamforming is actually a special case of a more advanced type of broadcasting called precoding. The beam pattern can be defined as a sum of products of a carrier wave and a spatial distribution function. The relationship between the emitted signal from each element and the input signal to each element is defined in a precoding matrix.



Figure 1 — The simplified analog beamforming framework

A simplified digital beamforming architecture is illustrated in the figure 2. In this case, each antenna element has its own dedicated RF chain as well as individual DACs and ADCs. Recalling the sampling analogy, this implies that the gain and phase of each spatial sample is adjusted in an individual manner along with baseband processing before up conversion at Tx or after

down conversion at Rx. This enables a true implementation of mathematical algorithms with maximum flexibility, most of which treat each antenna output as an accessible sample.



Figure 2 — The simplified digital beamforming framework

The advantages of digital beamforming are as follows:

— Along with maximizing the signal strength in a desired direction, nulls can also be created in undesired directions to suppress the interference.

— Multiple spatial streams can be simultaneously created for spatial multiplexing. More complicated precoders can be implemented for this purpose to generate multiple beams and enable multiuser communications. This is done by matrix multiplication in digital domain similar to the SVD decomposition.

— The beamforming weights, discussed in both physical and virtual scenarios, were for narrowband signals. A digital architecture allows for catering large bandwidths by selecting the weights for a frequency selective scenario. Wideband signal transmission and reception improves the spectral efficiency of the system by operating over a large signal bandwidth without beam squint.

The time windowing issue (essentially time-division multiplexing) is not appropriate for something like 5G with MU-MIMO, where orthogonal frequencydivision multiplexing (OFDM) is used to allow broadcasting of independently modulated orthogonal subcarriers. In addition, beamforming is used to enable spatial multiplexing within the array, which is essential for reaching multiple users.

Hybrid beamforming is a compromise between low power but less flexible analog beamforming and power hungry but fully flexible digital beamforming solutions. This two-stage architecture is drawn in the figure 3 where precoding or combining is done first in the analog part and later in the digital domain.

First, let's think about how this works with a set of input data streams:

1. The set of input data streams is first precoded as in digital beamforming.

2. Instead of outputting the stream directly to the entire array, the precoded streams are sent to individual analog beamformers, or sub-arrays.

3. The stream sent to each subarray is then phase shifted to produce a beam only from that sub-array, which is directed at the end user.

The antennas are using precoding to define a superposition among multiple beams for several data streams in order to achieve spatial multiplexing. As long as all elements in the precoding matrix are non-zero and complex, then all signals are sent to all antennas, but with mixed amplitude/phase combinations for each input stream. The result is the desired beamforming for each input data stream. In summary, both the digital and analog beamforming work together in this case to improve the coverage or to provide multiple beams to spatially separated users.

RF precoding/combining can be implemented through two different schemes:

An antenna array is divided into several subarrays, each forming an analog beamforming network and connected to its own RF chain. Since the subarrays operate more or less in an independent manner, the overall framework reduces complexity and power consumption at a cost of less flexibility. This is drawn in figure 4a. Each antenna is connected to all RF chains and the digitally controlled phase shifters are computed based on some jointly optimal criteria. This provides maximum flexibility in directing and manipulating multiple beams at a cost of complexity. Such an architecture is shown in figure 4b.



Figure 3 — The simplified hybrid beamforming framework The weights in digital and analog domains are chosen to closely approximate the optimal solution that results in minimum interference among the streams. The optimal solution is not trivial due to the number of antennas and subarrays involved as well as additional constraints that come with choosing imprecise analog weights. A trade-off needs to be made between performance and complexity [3].

To overcome the limitations of radio frequency devices and increase the bandwidth of the classic hybrid beamforming framework, it is proposed to use radio-over-fiber (RoF) technology.



Figure 4 — The structure of central distribution station module

The use of RoF communication systems (such as elastic radiooptical network (ERON)) for the backhaul and fronthaul access networks will become one of the most efficient solutions to enhance spectral efficiency of mm-wave communication systems and mitigate inter-user interference.

The key advantages of ERON are:

1. achieving low-cost, low-noise, low-power, and high-fidelity RFoptical signal processing via silicon photonic integrated circuits (Si-PICs) [7], while replacing the power-hungry mm-wave electronic circuitry and nonlinear electric phase shifters.

2. Unlike the baseband-over-fiber (BoF) approach that supports only one frequency band at a time, the RoF approach provides multiple bands multiple carrier signals so that multiple operators can coexist in a shared infrastructure without interference.

However, the relatively large propagation loss and limited scattering of mm-wave create new challenges for physical layer signal processing. To address these challenges, we propose a hybrid architecture that uses RF-optical processing units (RF-OPUs) to provide steerable beams and compensate the large propagation loss of mm-wave.

Proposed RoF system structure operating with hybrid precoding-based that can bring connection ubiquity, mobility, and interference suppression in multi-user scenarios.

The architecture shown in Figure 4b can be converted for Millimeter Wave RoF Systems, as shown in Figure 5.



Figure 5 — Photonic hybrid precoding structure for mm-wave multi-user MIMO systems

Proposed a multi-user MIMO system equipped with M transmit antennas per user. The system is operating in the ERON and consisting of a digital baseband precoder, located at the central office, and an analog photonic beamformer; at the transmitter (RAU), while the receiver at user k uses only an analog electronic combiner; as shown in Fig. 5: At the output of the baseband precoder, the data streams for the K users is the vector of information-bearing symbols for transmission to user k) are carried on optical carriers and precoded into a set of RF chains (DACs) which is subject to the constraint. Each DAC is connected to a dynamic optical arbitrary waveform generator (AWG), which is, in turn, used to generate optical carrier wavelengths n through an inphase and quadrature (IQ) optical intensity modulators array [3].

Conclusion.

Proposed a hybrid precoding structure for Roof systems. The system architecture considers both the flexibility and the robustness to conventional RF precoders inaccuracy. The photonic hybrid precoding systems aim to overcome the large propagation loss and reduce channel estimation cost at mm-wave. The photonic hybrid precoders can efficiently overcome multiuser precoding design problems at mm-wave, by enabling analog photonic beamformers to increase the power gain and mitigate inter-user interference.

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UDC621.3

DATA ACQUISITION SYSTEM FOR HYDROLOGY

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Аннотация.В статье рассматривается построение системы сбора гидрологической информации, содержащей дрейфующие и якорные приемопередающие буи с микроконтроллерной системой обработки и хранения данных, в том числе программируемые гидрологические зонды с датчиками для сбора параметров гидрофизических полей морской среды, таких как температура, соленость и плотность.

Ключевые слова: среда, система сбора данных, канал связи, микроконтроллер.

Annotation. The article discusses the construction of a hydrological data collection system containing drifting and anchoring transceiver buoys with a microcontroller data processing and storage system, including programmable hydrological probes with sensors for collecting parameters of hydrophysical fields of the marine environment, such as temperature, salinity and density.

Keywords: environment, data collection system, communication channel, microcontroller.

Introduction

Currently, there is a need to use hydrological networks, within which automated hydrological complexes are being actively introduced.

As a system for obtaining information about the state of the environment, you can use a network that includes a system of stationary and mobile data collection points designed to monitor the physical and chemical processes occurring in the environment, determine its hydrometeorological and geophysical characteristics, and a space observation system.

The values of the measured hydrological parameters obtained with the help of automated hydrological complexes are transmitted via communication channels to the data collection center. In this case, unmanned aerial vehicles launched from ships and satellite data channels are used. The information transmitted from the buoy stations is used for operational purposes, and also replenishes the hydrological database of the centers for hydrometeorology and environmental monitoring.

The hydrological system is buoy stations located in a certain area of the ocean, which are data collection platforms and allow long-term monitoring and collection of parameters of the hydrophysical fields of the marine environment over large areas according to the spatial and temporal distribution of parameters. These stations are made of free drifting and anchor buoys.

Mainpart

The presence of a transceiver capable of communicating based on a wireless network using a radio channel makes it possible to transmit the received data from individual buoys to other devices: ships, unmanned aerial vehicles and satellites, as well as receive control signals from them

The system of buoy stations is two-level [3, 6]. At the first level, bike stations are used, which are data collection platforms. The collected data on the parameters of the environment are transmitted to the leading buoy stations, which collect data from the buoy stations of the first level, store them and transfer them to the centers of hydrometeorology and environmental monitoring. The location of buoy stations is determined using the GPS satellite positioning system.

The buoy station consists of two parts - the measuring part and the device for processing and transmitting information.

The measuring part is presented as a set of hydrological probes containing temperature, density and salinity sensors. As additional sensors, current velocity and acceleration sensors are used. Sensors are located both on the submersible part of the buoy and inside the buoy.

A SeaGuard RCM hydrological probe was chosen as a device for measuring water parameters, designed to measure the speed of water flow, water temperature, electrical conductivity of water, hydrostatic pressure, mass concentration of oxygen dissolved in water.

The principle of operation of the SeaGuard RCM probe is based on the measurement of oceanographic parameters by primary measuring transducers with subsequent conversion of the received signals into a digital code [7]. The ZPulse water flow sensor is based on the Doppler effect. Four transducers emit short pulses along narrow beams, the same transducers capture the signals reflected from suspended particles (minerals, plankton, bubbles) in the water, the resulting frequency shift is used to calculate the current flow rate. The 4319 water conductivity sensor is based on the inductive principle: the current induced in the coil is converted into a conductivity value. The 4835 and 4330 Dissolved Oxygen Sensor is based on the ability of individual substances to dynamically quench fluorescence.

For air temperature measurements, a temperature sensor on a MAX6675 chip [5] is used, which is installed in the upper part of the buoy, this protects it from the effects of the external environment, the sensor performs cold junction compensation and generates a digital signal from a type K thermocouple. The data is output in a format available only for reading, with a resolution of 12 bits, compatible with the SPI interface. This sensor detects the air temperature with an accuracy of 0.25°C.

Accelerometer ADXL345 [1] measures the projection of the difference between the true acceleration of an object and gravitational acceleration, is a microelectromechanical system (MEMS). Data transfer is carried out using the SPI protocol. The ADXL345 accelerometer is capable of measuring acceleration up to ± 16 g, with a maximum resolution of 13 bits, and the measurement frequency reaches 3.2 kHz. The advantage of the ADXL345 accelerometer is low power consumption, the current consumption does not exceed 140 μ A. The use of this sensor makes it possible to determine the state of the sea surface, which is characterized by the height of the waves and their period.

Free-drifting buoy stations are equipped with a portable dual-frequency single-beam echo sounder HydroLite-DFX [4]. The use of two frequencies 30kHz / 200kHz allows the signal from the hydroacoustic antenna to penetrate soft sediments to determine the hard bottom boundary of the soil, as well as display the surface layer of soft sediments, and perform bottom topography survey inside any water area (ports, lagoons, bays).

Echosounder beamwidth $9^{\circ}/18^{\circ}$, burst rate: 6 Hz, data output is 2 Hz, depth measurement accuracy is 1 cm or 0.1% of depth. Sonar data output format NMEA, ASCII, ODOM, ATLAS, range of measured depths from 0.1 m to 200 m.

As a power source, an autonomous power supply battery for telemetry systems and geophysical equipment FPLT-01062PPS with a nominal voltage of 3.93 V, an operating temperature of -20° C to $+165^{\circ}$ C, a capacity of 6.2 Ah, an operating current of 50 mA and a peak current 500 mA [2].

The ADC is based on the ADC STM32 data acquisition module.

The device for processing and transmitting information is equipped with a GeoS-1 GPS receiver of the GLONASS system [8], and an STM32F4 microcontroller is used as a control device. The device has a slot that supports memory cards up to 64 GB and MBee-2.4-2.1-SMA-PLS12 2.4 GHz wireless radio (ZigBee PRO, RF4CE) This low power radio allows you to communicate with other devices in a line of sight up to 3000 m.

External probes are placed on a cable-rope, the upper part of which is attached to the buoy.

Structurally, the probes are built on a modular basis and are a measuring platform with a data logger, communication lines and connectors for connecting sensors

The hydrological data acquisition system can operate in three modes:

– offline mode, in which the received data is recorded on an SD memory card

for their subsequent transfer to a computer, processing and visualization;

- real-time mode, in which data can be displayed in real time without a request from an external device via a radio channel;

- mode of data transmission on request from an external device via a radio channel.

Conclusion

A hydrological data collection system has been developed that contains sets of two-level buoy stations that measure hydrological parameters, store them, and transmit them to centers of hydrometeorology and environmental monitoring. System control and data transmission is carried out using unmanned aerial vehicles, ships and satellites.

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UDC 621.3

INFLUENCE INVESTIGATION OF THE INFLUENCE OF THE BENDING OF CONDUCTORS OF A SYMMETRIC VIBRATOR ON ITS CHARACTERISTICS

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Аннотация. Рассмотрена возможность уменьшения размеров вибратора за счет изгиба его плеч под углом 90°. Исследована зависимость влияния точки изгиба на характеристики излучения антенны.

Ключевые слова: симметричный вибратор, диаграмма направленности, проволочная антенна.

Annotation. The possibility of reducing the size of the vibrator due to the bending of its arms at an angle of 90° is considered. The dependence of the influence of the bending point on the radiation characteristics of the antenna has been studied.

Keywords: symmetrical vibrator, radiation pattern, wire antenna.

Introduction

The vibrator antenna is one of the most popular types of antennas used in radio and communication systems. This is a simple but effective antenna that consists of two conductive elements symmetrically placed along a central axis. The length of each element is usually half the wavelength of the transmitted or received signal. This length determines the resonant frequency of the antenna.

One of the advantages of vibrator antennas is their simplicity. They are easy to make and can be made from a variety of materials, including wire, tubes, or printed circuit boards. They are also relatively inexpensive compared to other types of antennas, making them a popular choice for many applications.

Vibrator antennas are a simple yet effective type of antenna that is widely used in radio and communications systems. They have many advantages, including ease of fabrication, efficiency, and a weakly directional radiation pattern [1, 2, 4].

If you introduce bends in the antenna conductor, its dimensions are reduced. In this paper, a single bending of vibrators at an angle of 90° is investigated.

Mainpart

For the study, we will use the Feko antenna simulation program [3].

With Feko, a wide range of antenna types can be modeled and analyzed, including wire antennas, patch antennas, reflector antennas, and others. The software provides detailed information on key metrics such as gain, directivity, radiation pattern, radiation pattern, and impedance matching.

The software supports frequency and time domain simulations and also includes a number of advanced features such as 3D simulation, automatic meshing and optimization tools.

In fig. 1 shows a model of a vibrator with bent conductors and its radiation pattern.



Fig. 1 – Directional pattern of a symmetrical vibrator with bent conductors

In the considered model, the total length of the conductor remains constant, only the place of the bend changes. This results in a change in the antenna pattern and a change in the input impedance of the antenna.

Table 1 shows the values of the antenna gain depending on the place of the bend, which is characterized by the value l — the distance from the edge of the vibrator to the place of the bend. Table 2 shows the dependence of the change in the resonant frequency on the parameter l.

Parameter	0,47	0,93	1,87	2,9	3,75	6,5
Gain	2,5	2,4	2,35	2,25	2,0	1,36

Table 1 — Influence of the parameter l on the gain

0,3

Table 2 — Influence of the parameter l on the resonant frequency									
Parameter <i>l</i> , cm	0,47	0,93	1,87	2,9	3,75				
Resonance frequency	0.2	0.69	2.05	2.7	5.4				

Conclusion

0.68

2,05

2,7

5.4

Thus, the dependence of the characteristics of the vibrator antenna on the position of the bending point of the vibrator conductor has been studied. The dependences of the gain and resonant frequency on the position of the bending point of the antenna conductors are calculated.

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EFFECT OF THE DISTANCE BETWEEN THE ANTENNA AND THE MOUNTING SURFACE ON ITS RADIATION CHARACTERISTICS

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Аннотация. Рассмотрена работа антенны при наличии внешних факторов, влияющих на диаграмму направленности антенны. Исследована зависимость излучения антенны от расстояния ее размещения от стены здания.

Ключевые слова: распространение радиоволн, отражение радиоволн, поглощение радиоволн.

Annotation. The operation of the antenna in the presence of external factors affecting the antenna radiation pattern is considered. The dependence of the radiation of the antenna on the distance of its placement from the wall of the building has been studied.

Keywords:propagation of radio waves, reflection of radio waves, absorption of radio waves.

Introduction

The influence of external factors on the radiation characteristics of antennas and the formation of an electromagnetic field in the far zone can be considered using the example of radio links of wireless communication systems that are actively developing at the present time. Wireless communication systems use the 900 MHz, 2.4 GHz, 5 GHz bands and operate in urban areas.

The propagation of radio waves in urban areas or rough terrain is more complex than the propagation of radio waves in open space. This is due to the reflection of radio waves from obstacles at different angles and the superposition of the reflected waves and the main wave in space. As a result, a complex picture of the field distribution is obtained: the maxima of the field strength alternate with minima. The strength differences can reach 30 dB when changing the distance within the wavelength.

Mathematical analysis of the field distribution in space is possible only for the simplest cases; therefore, empirical approaches based on numerous experiments are widely used in this area [2-4].

Mainpart

For the study, we will use the program for modeling antennas MMANA [1]. The computational basis of MMANA is the MININEC Ver.3 program, which allows modeling the processes of the influence of shielding barriers on the formation of the electromagnetic field of the antenna and radiation characteristics with sufficient accuracy for research purposes.

It is also necessary to take into account some restrictions introduced into the computational core of the program to reduce the calculation time. When Real Ground is set, MININEC assumes an ideal ground to calculate the input impedance of the antenna. The real ground (with all its description) is taken into account only when determining the field in the far zone, and, therefore, when calculating the antenna gain and the shape of its RP. Also, keep in mind that the active parts of the impedances of low-hanging (lower than about 0.25 wavelength) horizontal antennas will be somewhat less than the real ones, since they are calculated for an ideal earth.



Fig. 1 –Antenna radiation pattern for various distances between the antenna and the building wall

For the study, a simplified layout of the antenna on the wall of the structure was used. An antenna with horizontal polarization is located parallel to the shielding surface S, at a distance h from it.Let us consider how the distance h from the obstacle affects the shape of the pattern. In this case, we first set the dielectric permittivity and properties of the metal to the barrier material.

In fig. 1 shows the antenna pattern in free space in black, red for $h=\lambda$, green for $h=3\cdot\lambda/4$, gray for $h=\lambda/2$, blue for $h=\lambda/4$. It can be seen from the

figure that the distance to the barrier strongly affects the shape of the pattern at $h<\lambda$. As h increases, the angle of maximum radiation decreases, and the RP becomes already in the horizontal plane. However, at $h\geq\lambda/2$, lobes appear, the number of which increases with a further increase in h, and the pattern becomes strongly indented, which worsens the directional properties of the antenna.

Conclusion

Thus, the dependence of the characteristics of the antenna on the distance of the antenna from the wall of the building has been studied. The strongest influence on the radiation of the antenna in the far zone is at $h < \lambda$.

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MODERNIZED LOG-PERIODICANTENNA

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Аннотация. Представлены результаты моделирования модернизированной логопериодической антенны с криволинейной центральной линией.

Ключевые слова: логопериодическая антенна, изогнутая логопериодическая антенна, программа автоматизации, электродинамическое моделирование.

Annotation. The results of modeling a modernized log-periodic antenna with a curved center line are presented.

Keywords: log-periodic antenna, curved log-periodic antenna, automation program, electrodynamic simulation.

Introduction

At present, log-periodic antennas (LPA) are widely used, keeping their electrodynamic characteristics almost unchanged in a wide frequency band [1, 3, 4]. If the LPA is made with a bend in the antenna plane, then one should expect a small change in the input characteristics with a significant change in the radiation characteristics. This work is devoted to the study of such modernized LPA.

Mainpart

Log-periodic antennas are broadband antenna devices, consisting of a number of identical elements, each of which has a certain size and shape. The basic principle of operation of log-periodic antennas is to use a combination of wavelengths so that the antenna is effective over the entire frequency range.

One of the advantages of log-periodic antennas is that they can be used over a wide frequency range without the need for reconfiguration. This makes log-periodic antennas ideal for use in broadcasting and other applications where signals need to be transmitted or received at different frequencies.

In addition, LPAs are highly directional, which means they can transmit signals efficiently in a certain direction, which can be important when operating over long distances.

The disadvantage of log-periodic antennas is the complexity of their design, which requires an accurate calculation of the length and shape of each element. In addition, LPAs can be expensive to manufacture.

The antenna under study consists of two flat sheets located one above the other with a distance between the sheets of 0.8 cm. The central line is a quarter of a circle with a radius of 1.5 m. The period of the logarithmic structure is chosen to be 0.9. The distance between the nearest vibrators is taken equal to 0.15 of the length of the largest of them.

The antenna is built in such a way that the vibrators are perpendicular to the center line, the length of the smallest vibrator is 0.18 m, the largest is 1.68 m, the number of vibrators is 22 pcs.

This antenna is excited by a symmetrical source connected to the central lines of two canvases from the side of the smallest vibrator.

The antenna was investigated in the frequency range (80-800) MHz.



Fig. 1 – Antenna pattern: a) top view, b) side view

In the course of the study, a volumetric radiation pattern of a logperiodic antenna with a central line curved along a quarter of a circle at a frequency of 360 MHz (the middle of the antenna's operating range) was calculated. The volumetric radiation pattern of the antenna is shown in fig. 1 (top view) and fig. 2 (side view).

It has been established that the width of the RP of the studied antenna in terms of the half power level is $\Delta \Theta_{0.5} = 60^{\circ}$. The active part of the input resistance in the studied frequency range is about 100 ohms, with a deviation of \pm 50 ohms. The reactive part of the resistance in the studied frequency range is 10 ohms, with a deviation of \pm 50 ohms.

The antenna simulation was performed in the MMANA program [2], the computational basis of which (as well as many commercial simulation programs) is the MININEC Ver.3 program (which was created for the purposes of the US Navy at the Washington Research Institute).

Conclusion

The radiation pattern of the antenna rotates as the frequency changes within the operating frequency range with a practically unchanged shape. Thus, the simulation confirmed the assumption made about a small change in the input characteristics with a significant change in the radiation characteristics for the modernized LPA.

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CNN MODELS FOR DETECTING DIABETIC RETINOPATHY

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Scientific advisor, PhD, Department of Information Systems, SevastopolStateUniversity Аннотация. В данной статье рассмотрены модели для распознавания диабетической ретинопатии у пациентов с помощью глубокого обучения. Были рассмотрены следующих модели: ResNet, EfficientNet и Swin. На основе данных моделей выполнено обучение с предварительной обработкой. Проведена настройка гиперпараметров. Было выполнено сравнение производительность моделей с точки зрения размера сети и точности. Результаты эксперимента показывают, что ResNet и EfficientNet имеют гораздо меньше параметров, чем Swin, и более эффективны в вычислениях, но Swin может достичь большей точности и надежности в этой задаче классификации.

Ключевые слова: Диабетическая ретинопатия, архитектура, модель, изображение, точность, нейронная сеть.

Annotation. This paper reviews models for recognizing diabetic retinopathy in patients using deep learning. The following models were considered: ResNet, EfficientNet and Swin. Based on these models, pre-processing training was performed. Hyperparameters were adjusted. The performance of the models has been compared in terms of network size and accuracy. The results of the experiment show that ResNet and EfficientNet have much smaller parameters than Swin and are more computationally efficient, but Swin can achieve greater accuracy and reliability in this classification problem.

Keywords: Diabetic retinopathy, architecture, model, image, accuracy, neural network.

Introduction

Diabetic retinopathy (DR) is a complication of diabetes that affects the eyes, damaging the blood vessels of the retina. The authors in their article "Detection of diabetic retinopathy using deep learning methodology" gave a detailed explanation of diabetic retinopathy, emphasizing that it initially proceeds asymptomatically or causes temporary visual impairment, which makes it difficult to detect at the initial stage of the disease. Severe form of the disease leads to partial or complete loss of vision. Thus, the detection of DR at an early stage is crucial to prevent complications of the disease. To diagnose this disease, professionals and specialists with highly effective equipment and techniques are required [3]

To be able to solve the problem of determining diabetic retinopathy using deep learning, data is needed. The sources of the necessary data, as well as working with them, are successfully described by the authors Gazala Mushtaq and Farheen Siddiqui. The authors take data from the Diabetic Retinopathy Detection 2015 and APTOS 2019 blindness detection kits from kaggle. Both datasets contain thousands of retinal images in various conditions. Both eyes are taken for each case. Since the images come from different sources, cameras - they contain a large amount of noise that must be removed. A preprocessing stage of images is required for deletion. The degree of diabetic retinopathy was assessed on a scale of 0 to 4.

The article "Analysis of diabetic retinopathy (DR) based on deep learning" by authors Abdul Muiz Fayyaz, Muhammad Imran Sharif, Sami Azam, Asif Karim and Jamal El-Den clearly describes a unique and effective system based on deep learning for determining retinal damage [1].

A small number of retina images are loaded with different parameters. The resize function scales images to a resolution of 1000 pixels on each side. After that, the vertical and horizontal axes are inverted. The AlexNet and Resnet models can be used to extract features. Image characteristics are extracted from fully connected layers of the model. The final classification is determined by running the selected characteristics through several cores of the support vector machine.

1 Methods

Having a set of retinal images, the authors Xu Shunyao, Huang Zixin, Zhang Yuhan in the article "Recognition of the progression of diabetic retinopathy using the deep learning method" described the necessary deep learning model development that can accurately recognize the disease [2].

Disease recognition refers to the tasks of image classification. The CNN model has high recognition accuracy.

There are various CNN model structures with pre-trained weights as transfer training. The architectures that will be considered are ResNet 50, EfficientNet DenseNet-169 and Swin.

1.1 ResNet-50

ResNet-50 is a very widely used neural network architecture, which is a convolutional network with 50 layers (48 convolutional layers, 1 layer of maximum unification and 1 layer of average unification). It uses pre-trained weights.

The residual coupling in this architecture between layers helps mitigate the problem of precision saturation. A short connection is added to perform identity mappings.

The authors Xu Shunyao, Huang Zixin, Zhang Yuhan in the article "Recognition of the progression of diabetic retinopathy using the deep learning method" [2] showed how to implement disease recognition with a basic ResNet-50 model in several steps.

Hyperparameters used in training:

1) batch size: 8;

2) epoch: 30;

3) warm-up era: 2;

4) learning rate: 0.0001;

5) the learning rate in the warm-up: 0.001.

1.2 The EfficientNet

The EfficientNet model is a combined scaling and learning method that uniformly zooms across all depth/width/resolution measurements with fixed scaling factors. The reason why the authors Xu Shunyao, Huang Zixin, Zhang Yuhan in the article "Recognition of the progression of diabetic retinopathy using the deep learning method" [2] need to perform image scaling for training in all dimensions is that these measurements affect the final accuracy of training and the choice of the network course. For example, if the image resolution is higher, then a deeper network is required to obtain larger receptive fields and a wider network to capture more subtle patterns.

In the combined scaling method, the values of depth, width and resolution are averaged and defined as:

depth :
$$d = \alpha \phi$$

width : $w = \beta \phi$
resolution : $r = \gamma \phi$

where α , β , γ are constants obtained as a result of a small grid search. By changing the value of ϕ and zooming in, you can get different versions of the models of the EfficientNets family.

Hyperparameters in training:

1) batch size: 8;

2) epoch: 10;

3) warm-up era: 3;

4) learning rate: 0.0001;

5) training speed in warm-up: 0.001.

1.3 Swin

The Swin Transformer model, which the authors Xu Shunyao, Huang Zixin, Zhang Yuhan decided to use in the article "Recognition of the progression of diabetic retinopathy using the deep learning method" [2], corresponds to the Swin-B architecture.

Initially, the input image 224×224 RGB is divided into sections. The plot size is used at the beginning equal to $4 \times 4 \times 3 = 48$. Then this dimension is linearly converted from 48 to 128 (moving to the Swin-B version).

Swin transformation blocks are divided into four stages to perform feature transformation, where each stage contains 2, 2, 18, 2 converter blocks, respectively. This representation helps to solve the problem of different scales and to level the linear computational complexity in relation to the image size.

Hyperparameters in training:

1) batch size: 32;

2) learning rate: 0.001;

3) epoch: 10;

4) decay steps: 100;

5) decay rate: 0.95.

We will also conduct a review of two other neural networks from another study by the authors Abdul Muiz Fayyaz, Muhammad Imran Sharif, Sami Azam, Asif Karim, Jamal El-Den of the article "Analysis of diabetic retinopathy (DR) based on deep learning" [2].

1.4 AlexNet

The authors of the article proposed an 8-layer deep architecture of Alex Net. AlexNet contains five deep convolutional layers and three fully connected layers. This network uses the rectified linear unit (ReLU) function instead of the sigmoid function to solve the problem of vanishing gradients and fast learning. The merge operation is used to reduce the size of the space. The size of fully connected layers (FC6 and FC7) is 4096 features. For the last fully connected layer, which is called the "output layer", the size of FC8 is 1000 features. During the study, the learning accuracy was 93.0, which is a good indicator for a class of such networks.

1.5 Densenet-169

For preprocessing using the DenseNet model, it is necessary to remove the black border of the images in order to focus more only on the image, it is also necessary to remove the black corners of the images, then the size of the images should be changed to 256*256 pixels. It is also necessary to apply Gaussian blur to the images to remove Gaussian noise. After preliminary processing, the authors found that the data is highly unbalanced by classes and most of the data belongs to class "0", i.e. without others. To solve this problem, the authors used data augmentation, which gave the authors 7000 images from each class and made the data balanced.

After training and evaluating the model, the authors obtained a training accuracy of 0.953, and a validation accuracy of 0.9034. We also calculated the Cohen Kappa coefficient, which was 0.804. The authors also applied a regression model to a data set and calculated its validation accuracy (0.789).

Conclusion

According to the results of the experiment conducted by the authors of the article [1], Swin- achieves the highest accuracy. Swin contains more parameters than ResNet and Efficient-Net. A larger number of parameters means a stronger representational ability, which makes it easier for the model to generalize training samples. In addition, Swin Transformer combines the advantages of CNN in technical vision tasks with the powerful Transformer architecture. But as a result, ResNet-50 is the most computationally efficient, followed by EfficientNet-B5, these two CNN models are less competitive in terms of accuracy compared to Swin Transformer, but the best transformer performance is achieved at the cost of computational and time costs. When choosing models, there is a trade-off between accuracy and efficiency. In turn, the DenseNet-169 and AlexNet Deep CNN models, which are described by the authors, are a good alternative to Swin Transformer in accuracy, but are also quite time-consuming and long-learning [1]

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INVESTIGATION OF DIRECTLY LEARNING PREDICTION ALGORITHMS (DLA)

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нелинейная Аннотация. В этой статье рассматривается физическая Вольтерра алгоритмов система с использованием обучения адаптации, основанных на архитектуре прямого (DLA).Произведена оценка эффективности существующих алгоритмов адаптации таких как: алгоритм нелинейного наименьшего среднего квадрата фильтрацией (NFxLMS) и алгоритм нелинейного с рекурсивного наименьшего квадрата с фильтрацией (NFxRLS), нелинейный метод ошибки прогнозирования с фильтрацией (NFxPEM). Приведены результаты сравнения работы алгоритмов предискажения.

Ключевые слова: Предискажение; Постискажение; Архитектура прямого обучения (DLA); Архитектура косвенного обучения (ILA); Компенсация нелинейности.

Annotation. This article discusses the nonlinear Volterra physical system using adaptation algorithms based on the Direct Learning Architecture (DLA). The efficiency of existing adaptation algorithms such as the nonlinear least mean square algorithm with filtering (NFxLMS) and the nonlinear recursive least square algorithm with filtering (NFxRLS), the nonlinear prediction error method with filtering (NFxPEM) is evaluated. The results of a comparison of the operation of the pre-order algorithms are presented.

Keywords: Predistortion; Postdistortion; Direct Learning Architecture (DLA); Indirect Learning Architecture (ILA); Compensation of nonlinearity.

In the DLA approach, a nonlinear predistortion source is connected in series with a nonlinear physical system (Fig. 1).



Fig. 1 — Block diagram of the adaptive predistortion algorithm using the DLA approach

The pre-emphasis source coefficients are estimated directly using the feedback error signal e(n) and adaptation algorithms. The error signal e(n) is the difference between the reference signal r(n) and the system output measurement defined as

 $\tilde{z}(n) = z(n) + v(n),$ (1) where z(n) — the clean output of the nonlinear physical system, v(n) — zero-mean Additive White Gaussian Noise (AWGN). The reference signa $\tilde{r}(n)$ is usually defined $\tilde{r}(n) = x(n - \tau)$,

where τ — the time delay caused by the overall system consisting of the predistorter and the nonlinear physical system.

(2)

Therefore, the error signal can be written as

 $e(n) = \tilde{r}(n) - \tilde{z}(n) = \tilde{r}(n) - v(n) - \tilde{z}(n).$

Predistortion algorithm using the Volterra system

This section presents adaptation algorithms for predistorting Volterra systems using the DLA approach. The NFxLMS and NFxRLS algorithms are considered first, and then the NFxPEM algorithm is derived. Simulation results for comparison of these algorithms are given at the end of the article.



Fig. 2 - DLA approach for pre-distortion of Volterra systems

The DLA approach for pre-emphasis of Volterra systems is shown in fig. 2. Nonlinear physical system *H* is a *q*-th order Volterra series with input and output signals y(n) and z(n), respectively. The output signal z(n) is given by

$$Z(n) = h^{T}y(n) = \sum_{k=1}^{q} h_{k}^{T}y_{k}(n) = \sum_{k=1}^{q} \left(\sum_{i_{1}=0}^{M_{k}-1} \cdots \sum_{i_{k}=0}^{M_{k}-1} h_{i}(i_{1}, \cdots, i_{k})y(n-i_{1}) \cdots y(n-i_{k}) \right),$$
(3)

where M_k — the memory length of the kth order kernel.

The kernel vector h is defined as

$$h = \begin{pmatrix} h_1^T \dots h_q^T \end{pmatrix}^T,$$
(4)
$$h_k = \begin{pmatrix} h_k(0, \dots, 0) \\ \vdots \\ h_k(1, \dots, k) \\ h_k(M_k - 1, \dots, M_k - 1) \end{pmatrix}, k = 1, \dots, q.$$
(5)

and the input vector y(n) is defined as

$$y(n) = \left(y_1^T(n) \dots y_q^T(n)\right)^T,$$
(6)

$$y_{k}(n) = \begin{pmatrix} y^{k}(n) \\ \vdots \\ y(n-i_{1})\cdots y(n-i_{k}) \\ \vdots \\ y^{k}(n-M_{k}+1) \end{pmatrix}, k = 1, \cdots, q.$$
(7)

Similarly, the relationship between the input and output of an adaptive Volterra predictor is C(n). It should be noted that the kernel vector c(n) of the Volterra adaptive predictor shows a clear dependence on the time index n, where the kernel vector h of the nonlinear physical system is considered time invariant. In accordance with the inverse theory of the p-th order [3, p.288], the Volterra predictor C(n) can remove non-linearities up to the p-th order, provided that the inversion of the first-order kernel of the Volterra system H is causal and stable. The topics of the following subsections are evaluation of the kernels C(n).

Nonlinear Least Mean Squares (NFxLMS) Predistortion Algorithm

The NFxLMS algorithm in [1, p.13] is obtained by applying the stochastic gradient algorithm as

$$c(n+1) = c(n) - \frac{\mu}{2} \Delta^{T}(n), \P$$
(8)

where μ — the step-size parameter, is a small positive constant that controls stability and rate of convergence of the adaptation algorithm.

The gradient vector $\Delta(n)$ is defined as

$$\Delta(n) = \nabla_{c(n)} e^2(n)(9)$$

The NFxLMS algorithm estimates the pre-emphasis source coefficients by minimizing the mean square error (MSE), defined as

 $E\{e^{2}(n)\} = E\{(r(n) - z(n)^{2}\},$ (10)

Where $E\{.\}$ — denotes the Expectation.

Using (10) to simplify (9), we obtain

$$\nabla_{c(n)}e^2(n) = -2\mathbf{e}(n)\nabla_{c(n)}z(n),\tag{11}$$

where $\nabla_{c(n)} z(n)$ can be written in the form (3)

$$\begin{aligned} \nabla_{c(n)} z(n) &= \sum_{r=0}^{M-1} \frac{\partial z(n)}{\partial y(n-r)} \nabla_{c(n)} y(n-r) = g(r;n) \nabla_{c(n)} y(n-r). \end{aligned} \tag{12} \\ \text{Here} M &= max \left\{ M_1, \cdot, M_q \right\} \text{ and} g(r;n) \text{ is given by} \\ g(r;n) &= \frac{\partial z(n)}{\partial y(n-r)} = h_1(r) + 2 \sum_{i=0}^{M_2-1} h_2(r;i) y(n-i) + 3 \sum_{i_1=0}^{M_3-1} \sum_{i_2=0}^{M_3-1} h_3(r,i_1,i_2) y(n-i_1) + \cdots \end{aligned}$$

Where $h_k(r, i_1, \dots, i_k)k = 1, \dots, q$ equals to 0, when $M_k < r \le M$. Assuming, that μ is chosen sufficiently small so that the kernel vector c(n) is changing slowly, $\nabla_{c(n)}y(n-r)$ can be approximated by analogy with (6). Then we get

$$\nabla_{c(n)}y(n-r) \approx \nabla_{c(n-r)}y(n-r) = x^{T}(n-r).$$
Substituting 12—14 into 11 we get

$$\Delta(n) = \nabla_{c(n)}e^{2}(n) = -2e(n)\sum_{r=0}^{M-1}g(r;n)x^{T}(n-r).$$
(15)

In (13) it is assumed that the correct kernels of the nonlinear physical system H are known or estimated. The problem of estimating Volterra kernels for nonlinear systems is described in [1, p. 14].

Least Mean Squares (NFxRLS) Recursive Nonlinear System Predistortion Algorithm

The NFxRLS algorithm in [2, p. 15] was obtained by minimizing the NFxLMS function

 $\xi(n) = \sum_{i=1}^{n} \lambda^{n-i} e^2(i) = \sum_{i=1}^{n} \lambda^{n-i} (r(i) - z(i))^2, \quad (16)$ where $0 < \lambda < 1$ — is an exponential forgetting factor and r(i) is defined similarly as in (2).

The NFxRLS algorithm is described in more detail in [2. p.15] and looks like this:

$$e(n) = r(n) - z(n);$$

$$k(n) = \left(\lambda + \varphi^{T}(n)P(n-1)\varphi(n)\right)^{-1}P(n-1)\varphi(n);$$

$$P(n) = \frac{P(n-1)-k(n)\varphi^{T}(n)P(n-1)}{\lambda};$$

$$c(n+1) = c(n) + k(n)e(n).$$
(17)

The most common choice for the initial condition P(n) is P(0) = pI, where *I* is the identity matrix and ρ is a constant that reflects the original kernel vector c(0).

Predistortion Algorithm in a Nonlinear System by Predistorter Error Reduction (PEM)

The NFxPEM algorithm is obtained by minimizing the NFxRLS function and is described in [2, p.16].

$$V(c) = \lim_{N \to \infty} \frac{1}{N} \sum_{n=1}^{N} E[e^{2}(n)],$$
(18)

where e(n) — prediction error, which can be written as e(n) = r(n) - z(n) (19)

The formation of the NFxPEM algorithm requires a negative gradient e(n) with respect to c(n), which is defined as

$$\varphi^{T}(n) = \nabla_{c(n)} z(n) = \sum_{r=0}^{M-1} g(r; n) x^{T}(n-r), \qquad (20)$$

Where $M = max \{M1, \cdot, Mq\}$ and g(r; n) given in (13).

Therefore, the NFxPEM algorithm looks like this

$$e(n) = r(n) - z(n);$$

$$\lambda(n) = \lambda_0 \lambda(n-1) + 1 - \lambda_0;$$

$$s(n) = \varphi^T(n)P(n-1)\varphi(n) + \lambda(n);$$

$$P(n) = \frac{P(n-1)-P(n-1)\varphi(n)s^{-1}(n)\varphi^T(n)P(n-1)}{\lambda(n)}$$

$$c(n+1) = c(n) + P(n)\varphi(n)e(n).$$
(21)

Here $\lambda(n) - s$ a forgetting factor that grows exponentially to 1 as $n \rightarrow \infty$, where the rate $\lambda(0)$ and the initial value $\lambda(0)$ are design variables. The numerical values $\lambda_0=0.99$ and $\lambda(0)=0.95$ have proven to be useful in many applications.

Also, $P(n)=nR^{-1}(n)$, where R(n) is the Hessian approximation in the Gauss-Newton algorithm. The most common choice for the initial condition of P(n) is $P(0)=\rho I$, where I is the identity matrix and ρ is a constant that reflects

our trust in the initial kernel vector c(0). n case of no prior knowledge c(0)=0 and ρ is large to speed up convergence to the true parameter vector

Comparison of the results of the algorithms

The number of independent experiments is 100. In each experiment, the pre-emphasis input signal x(n) was chosen as a random signal with a uniform distribution over (-1, 1) with a data length of 2×10^4 , and the frequency band was limited by a low-pass filter to prevent aliasing on output *H*. The normalized cutoff frequency of this filter is chosen to be $\pi/4$, since after two cascaded 2nd order nonlinear systems C(n) and *H*, the bandwidthz(n) will be 4 times wider than the bandwidth x(n). The reference signal r(n) was chosen to be equal to the input signal x(n) with no delay as the linear subsystem *H* plus the measurement noise that was in AWGN such that the signal to noise ratio (SNR) was reached 40 dB.Comparison of MSD between NFxLMS, NFxRLS and NFxPEM algorithms is presented in fig. 3.



Fig. 3 — Graph of mean square distortion (MSD)

The step size of the NFxLMS algorithm was $\mu = 0.1$, and the matrix P(0)=100×I for the NFxRLS and NFxPEM algorithms. λ , $\lambda 0$, and $\lambda (0)$ were chosen to be 1, 0.99, and 0.95, respectively. The RMS of the non-linear physical system without pre-emphasis was about -16 dB. The NFxRLS and NFxPEM algorithms provide much lower distortion values than the NFxLMS algorithm. On average, the NFxLMS algorithm reaches about -23 dB after 2×10^4 samples, but it still doesn't converge. The NFxRLS algorithm converges after about 4000 samples and reaches about -40 dB. The NFxPEM algorithm converges after about 800 samples and reaches about -40 dB. Obviously, the NFxRLS and NFxPEM algorithms converge much faster than the NFxLMS algorithm.



Fig. 4 — Graph of the average power spectral density (PSD) for different adaptation algorithms

On fig. 4 shows the average PSDs of the output signals of the non-linear physical system without and with pre-emphasis after 2×10^4 samples. It can be seen from this figure that in the normalized frequency band $(0.30\pi, 0.55\pi)$, the NFxLMS algorithm can only reduce the spectrum growth to 5 dB. Compared to the NFxLMS algorithm, the NFxRLS and NFxPEM algorithms can reduce spectral growth more efficiently (up to 30 dB). For all algorithms, there is an increase in the spectrum in the normalized frequency band $(0.55\pi, 0.75\pi)$ caused by the cascaded nonlinear systems C(n) and H. However, this increase in the spectrum does not significantly affect the performance of the predistortion because it is relatively small (less than -80 dB).

Conclusion. In this paper, the adaptive prediction of nonlinear physical systems is considered using the DLA approach. The predistortion source coefficients can be estimated using time or frequency domain adaptation algorithms.

The NFxLMS algorithm is a fundamental time domain adaptation algorithm for predicting various non-linear systems such as Volterra, Wiener and Hammerstein systems. However, this algorithm requires accurate system identification of the nonlinear physical system and usually has a very low rate of convergence. The existing NFxRLS algorithm is capable of speeding up convergence, but can only be used to predict a non-linear system where the output of the pre-distortion is linear in its coefficients. The NFxPEM algorithm proposed in this paper can be implemented to predict various nonlinear systems. Based on the simulation results, it can be seen that compared to the NFxLMS algorithm, the NFxPEM algorithm has a very high convergence rate and is much more efficient in reducing the increase in the spectrum caused by a nonlinear physical system. Relaxing the requirement for precise system identification for Volterra and Hammerstein system prediction is still an open question for future research.

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INVESTIGATION OF THE APPEARANCE OF PREDISTORTION IN NONLINEAR SYSTEMS AND WAYS TO COMBAT WITH IT

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Аннотация.В настоящее время устранение или уменьшение эффектов нелинейных искажений является необходимым требованием во многих областях. Например, в системах беспроводной связи: множественного доступа с частотным разделением каналов (FDMA) и множественного доступа с кодовым разделением каналов (CDMA). Нелинейность УМ приведет к искажению групповых сигналов, росту спектра и искажению формы импульса сигнала.

Нелинейные искажения появляются также в:системах оптической связи(вызываемые лазерными диодами);акустических системах (динамики и микрофоныявляются основными источниками нелинейности).Небольшие искажения, вызванные нелинейными компонентами, могут влиять на общую производительность в: интегрированных фильтрах; радиосистемах; технике обработки речи и управления.

Ключевые слова:Предискажение, Постискажение, Архитектура прямого обучения (DLA), Архитектура косвенного обучения (ILA), Компенсация нелинейности.

Annotation.Currently, the elimination or reduction of the effects of nonlinear distortion is a necessary requirement in many areas. For example, in wireless communication systems: multiple access with frequency division of channels (FDMA) and multiple access with code division of channels (CDMA). The nonlinearity of the PA will lead to distortion of the group signals, an increase in the spectrum and distortion of the pulse shape of the signal.

Nonlinear distortions also appear in: optical communication systems (caused by laser diodes); acoustic systems (speakers and microphones are the main sources of nonlinearity). Small distortions caused by non-linear components can affect overall performance; integrated filters; radio systems; speech processing and control techniques.

Keywords: Predistortion; Postdistortion; Direct Learning Architecture (DLA); Indirect Learning Architecture(ILA); Compensation of nonlinearity.

Nonlinearity can be described using various types of nonlinear models, for example, the Volterra, Wiener and Hammerstein models. However, the main problem that arises when using Volterra models is the high computational complexity due to the large number of parameters.

The Volterra model is a general model for nonlinear systems, which can be described as follows

 $z(n) = h_0 + \sum_{k=1}^{\infty} \sum_{i_{1}=-\infty}^{\infty} \sum_{i_{2}=-\infty}^{\infty} \cdots \sum_{i_{k}=-\infty}^{\infty} h_{i_1,\cdots,i_k y(n-i_1)\cdots y(n-i_k)}, (1)$ where y(n) and z(n) —are the input and output signals, respectively; h_{i_1,\cdots,i_k} —the *k*th-order Volterra kernel of the system.

If $h_{i_1,\dots,i_k} = 0$ for all $i_k < 0$, the Volterra system is causal, and (1) becomes $z(n) = h_0 + \sum_{k=1}^{\infty} \sum_{i_1=0}^{\infty} \sum_{i_2=0}^{\infty} \dots \sum_{i_k=0}^{\infty} h_{i_1,\dots,i_k,y(n-i_1)\dots,y(n-i_k)}$ (2)

Normally, the memory length required to approximate a nonlinear system is finite, and the Volterra series is truncated to a finite order q, a finite-memory, finite-order Volterra series is obtained as

memory, finite-order Volterra series is obtained as $z(n) = h_0 + \sum_{k=1}^q \sum_{i_{1=0}}^{M_k-1} \sum_{i_{2=0}}^{M_k-1} \dots \sum_{i_{k=0}}^{M_k-1} h_{i_1\dots i_k y(n-i_1)\dots y(n-i_k)}, \quad (3)$ Where M_k — the memory length.

However, the main problem encountered while using Volterra models is high computational complexity due to the large number of parameters. For this reason, block-structured models such as Winer and Hammerstein models are considered in order to decrease the number of parameters - hence decrease the computational complexity [1, p. 2].



Fig. 1 — Flowchart: Wiener (a) and Hammerstein (b) models

Wiener and Hammerstein models are special cases of the truncated Volterra series [2. p.79], the structure of the Wiener model consists of a linear dynamical system followed by static nonlinearity. On the other hand, in the structure of the Hammerstein model, static nonlinearity precedes the linear dynamic system (Fig. 1). For these nonlinear models, it is assumed that only the input and output signals of the model are measurable.



The distortion caused by non-linearity can be easily observed in the frequency domain. If the system is described by a nonlinear model, then the output signal of the nonlinear model will contain new frequency components, namely spectral growth, compared to the input signal. Fig. 2 shows the power spectral densities (PSD) of the input and output signals of the Volterra system. The dotted line represents the PSD of the input signal, and the solid line represents the PSD of the output signal. It is quite obvious that a significant increase in the spectrum is observed in the normalized frequency band 0.30π — 0.55π .

To reduce the repeated growth of the spectrum, i.e., to reduce (compensate) nonlinear distortions, there are two types of linearization methods: pre-distortion and post-distortion (Fig. 3).



Fig. 3 — Block diagram of the system with: pre-distortion (a) and post distortion (b)

A nonlinear filter can be connected in a cascade before a nonlinear system (called a pre-distortion device) or after a nonlinear system (called a post-distortion device or equalizer), resulting in a general system whose characteristics correspond to the reference linear system. In many systems, pre-distortion is more effective than post-distortion. For example, in wireless communication systems, the MIND is an analog device, and its output signal is a radio signal. Consequently, the implementation of post-image requires the inclusion of a nonlinear filter (often adaptive) in the analog domain, which is difficult and expensive. In this case, pre-image is more suitable, since it can implement a pre-image device in the digital domain.

In adaptive pre-distortion, two important aspects must be taken into account in order to find the pre-distortion coefficients:

— learning architecture;

— adaptation algorithm.

In general, there are two learning architectures: direct learning architecture (DLA) and indirect learning architecture (ILA).



Fig. 4 — Block diagram of the direct learning algorithm

The basic scheme of the DLA approach is shown in Fig. 4. The nonlinear pre-distorter is connected in series with a nonlinear physical system. The coefficients of the pre-converter are evaluated directly using the feedback error signal and adaptation algorithms. The most commonly used adaptation algorithm is the nonlinear least-mean-squares algorithm with a filter (NFxLMS). However, the NFxLMS algorithm usually suffers from slow convergence. The algorithm of nonlinear recursive least squares with a filter (NFxRLS) was proposed in [3, p.2] to accelerate convergence, but it can be obtained only for the case in which the output data of the nonlinear physical system and the pre-distorter are linear in their coefficients.

The task is to find an adaptation algorithm with fast convergence and suitable for pre-distortion, regardless of the type of model of the nonlinear physical system and the pre-distortion. In addition, all the mentioned algorithms require adaptive system identification of a nonlinear physical system before adaptation by a pre-distorter.



Fig. 5 — Block diagram of the architecture with indirect learning ILA-I

ILA approaches can be divided into two types: the ILAI approach and the ILAII approach. The ILAI approach is demonstrated in Fig. 5. The predictor coefficients are a copy of the coefficients of the training filter connected as a post-discriminator to a nonlinear physical system. The coefficients of the training filter are estimated using error signal and adaptation algorithms. In [1, p.4], the training filter is modeled as a Volterra system, a static polynomial system and a polynomial system with memory, respectively. The well-known least squares (LS) method is used to estimate its coefficients. The LS method is also used to estimate its coefficients. However, noisy measurement of the output signal of a nonlinear physical system leads to the fact that the training filter converges to a biased estimate and, consequently, degrades the performance of the ILA-I approach.

In [1, p.5], a recursive least squares algorithm (RLS) was proposed, in which both the training filter and the pre—filter is modeled as Volterra systems.



Fig. 6 — A block diagram of the architecture with indirect learning ILA-II

The ILA-II approach was first proposed for the pre-distortion of Volterra systems. The structure of this approach is shown in Fig. 6. It is assumed that the Volterra system *H* is a weakly nonlinear system and can be divided into two subsystems, one of which is a fully linear subsystem H_L , and the other is a completely nonlinear subsystem H_N , where $H = H_L + H_N$. The

pre-converter can be constructed using H_N , an inversely proportional linear subsystem H_L^{-1} and a delayed input signal. To build a preliminary converter, the subsystems H_L , H_N are first identified using adaptive linear and nonlinear FIR filters, \hat{H}_L and \hat{H}_N is evaluated directly using the adaptive linear FIR filter \hat{H}_L^{-1} . Note that the input \hat{H}_L^{-1} must be the output \hat{H}_L , and it can use the output H assuming that H is a weakly nonlinear system. Then a preliminary converter is constructed by copying the estimated coefficients from \hat{H}_N and \hat{H}_L^{-1} to the pre-converter.

Conclusion

The proposed adaptive algorithm for estimating the coefficients H_L , H_N and H_L^{-1} in [1, p.5] is the least mean squares (LMS) algorithm. However, since the identification of Volterra systems using the LMS algorithm usually gives inaccurate estimates due to slow convergence, inaccurate estimates of H_N and H_L^{-1}) will then degrade the performance of the preliminary analysis. An important issue is the search for an adaptation algorithm to obtain more accurate estimates and, consequently, to improve the performance of the preliminary analysis.

Most of the existing adaptation algorithms based on these two architectures are time domain adaptation algorithms, pre-distortion using frequency domain adaptation algorithms is also an interesting topic for research, since pre-distortion is aimed at reducing the re-growth of the spectrum in the frequency domain.

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UDC 004.932:681.518.3:351.778 MACHINE VISION-BASED CHECKPOINT CONTROL SYSTEM

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Аннотация.В настоящее время, в связи с огромным количеством людей, посещающих места общего пользования, растут риски несчастных случаев, предумышленных преступлений и различных чрезвычайных ситуаций. Возможность пожаров, террористических актов, присутствия разыскиваемых лиц, все это является лополнительным фактором опасности. Поэтому, ланная статья посвяшена актуальной проблеме обеспечения безопасности учреждений с большим скоплением людей. Важной составляющей безопасности любого подобного места является контрольнопропускной пункт, через который проходят огромные массы людей, поэтому была разработана система, призванная улучшить качество его работы при помощи машинного зрения.

Ключевые слова: машинное зрение, цифровизация, автоматизация, безопасность, интеллектуальные системы.

Annotation. Nowadays, due to the huge number of people visiting public places, the risks of accidents, premeditated crimes and various emergencies are increasing. The possibility of fires, terrorist attacks, the presence of wanted persons, all this is an additional factor of danger. Therefore, this article deals with the urgent problem of providing security in institutions with large gatherings of people. An important part of the security of any such place is a checkpoint through which huge masses of people pass, so a system has been developed to improve its performance with the help of machine vision.

Keywords: machine vision, digitalisation, automation, security, intelligent systems.

Introduction

In today's world, digitalisation and automation systems have become widespread: in industry, for quality control of products, in the home, to facilitate and improve human life, in the public sphere, and for digitalisation of documents and payments. Naturally, these developments could not pass over the security of factories, public institutions and other crowded places. In such places, it is important to control the number of people who are present at a given moment in a building or on the ground, to identify them and to ensure they are legally present on the premises. This is necessary not only as a monitoring of workplace attendance and identity checks, but also for security in times of emergency. Knowing the initial number of people can ensure the most effective assistance is provided.

This task is solved quite simply. Each person has unique facial features that machine vision can recognise and thus carry out its own task. Thus, we propose the use of cameras connected to security systems with machine vision.

Video surveillance system

To date, RFID-based electronic badge systems have been used to solve security problems in public institutions [4]. But such security measures are only possible in places with limited human traffic, such as educational or some other public institutions, where, at the moment, no one is allowed without a badge. However, in the case of more open areas such as parks, subways, banks, cultural institutions, train stations etc., such security measures are not applicable.

A video surveillance system with machine vision does not need additional devices such as cards, chips or badges. Anyone caught by the camera will automatically be identified and logged by the system. The system can also generate notifications and alerts to checkpoint personnel if violations or threats are detected. Such a solution would reduce the cost of badge terminals and key cards.

Almost every public place is provided with high-speed Internet due to the development of modern technology,, which, in turn, makes it possible to generate data on third-party servers without much loss in speed, quality or power. Also, technological progress has touched the small computers, which can solve their tasks independently thanks to their own computing power. Such a solution, although somewhat more expensive, will increase its fault tolerance caused by the need to process data streams around the clock.

The Raspberry Pi series are small and inexpensive computers that run the Linux operating system or other Linux kernel-based systems. They have connectors for connecting a monitor, keyboard, mouse, network and other devices. In addition, they have a special port for connecting a Raspberry Pi camera that can take videos and photos, they provide enough performance to process real-time video streams using machine learning tools[3]. They also have Wi-Fi and Bluetooth wireless interfaces, allowing data to be transmitted to the institution's monitoring servers.

To create a video surveillance system for face identification, you can use Raspberry Pi in combination with Motion or motionEyeOS software. Motion is free and open source software that allows you to record videos or photos when motion is detected or at regular intervals, view live broadcast from cameras, run scripts when activity is detected and register activity in the database. motionEyeOS is a special version of the Linux—based operating system, which already has Motion built in and a web interface for its configuration and management.

An example of how such a system based on machine vision would work is shown in Figure 1:



Figure 1- Face recognition

The solution is easily embeddable in existing institution control systems, as the vast majority of such locations already have sufficient surveillance cameras that will not only detect incoming and outgoing people, but also transmit the location of unidentified persons to management, thus increasing institution security and more accurate monitoring of the number of people in the institution.

As a set of tools to be used in the method described in this article we propose to use OpenCV open source library system [2]. The use of these libraries will not only simplify and speed up the writing of software, but in most cases significantly improve the performance of many algorithms, thanks to the work on it by many large global companies.

OpenCV is a popular computer vision library that includes implementations of the latest face recognition algorithms. OpenCV provides the FaceRecognizer class that allows use different methods of face recognition, such as Eigenfaces, Fisherfaces and Local Binary Patterns Histograms[6]. First need to detect faces in the image using a face detector in our case, this is a surveillance camera, for example, HaarCascade or DNNbased[5]. Then you need to select the area of interest (ROI) with the face and convert it to a standard size and color space.Next, you need to extract features from the ROI using one of the face recognition methods, for example, Eigenfaces, Fisherfaces or Local Binary Patterns Histograms. Finally, it is necessary to compare the extracted features with a database of known persons and determine the most appropriate match using a distance metric or classifier[1]. It is worth considering that the face recognition algorithm will need to be trained for each building since it should be able to identify the employees of the company working in the building and count and check the database.

Conclusion

Based on the above, we can conclude that the use of modern image processing methods will increase the degree of automation of video surveillance and security systems, while improving the quality and quantity of information obtained on the number and identity of people in the institution, which in turn will increase security in emergency situations such as fire, as well as gather statistical information on attendance at work or training processes. Another benefit is the opportunity to improve the efficiency and profitability of many of the processes that take place.

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SECTION 3: HISTORY, THEOLOGY, SOCIOLOGY



UDC 902/904

NOMADIC LIFE OF THE SCYTHIANS

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Аннотация. В данной статье рассмотрены вопросы, касающиеся быта и культуры скифов. Проанализированы характерные особенности искусства скифских племен. Автором показано, что успехи скифов в развитии их культуры оказали значительное влияние на историю и культуру последующих народов Юга России. По мнению автора, скифский мир внес неоценимый вклад в сокровищницу общечеловеческой культуры. В статье делается вывод, что до сих пор остается неясным история этого народа, его появление и последующее «исчезновение», корни его культуры и социальные предпосылки государственности.

Ключевые слова: Крым ,скифы, быт, культура, искусство, ,звериный стиль, триада.

Annotation. This article deals with issues related to the life and culture of the Scythians. The characteristic features of the art of the Scythian tribes are analyzed. The author shows that the success of the Scythians in the development of their culture had a significant impact on the history and culture of the subsequent peoples of the South of Russia. According to the author, the Scythian world made an invaluable contributioninto the treasury of human culture. The article concludes that the history of this people, its appearance and subsequent "disappearance", the roots of its culture and the social prerequisites for statehood are still unclear.

Keywords: Crimea, Scythians, life, culture, art, animal style, triad.

Introduction and Relevance.

The Crimea has long been inhabited by people belonging to various ethnic groups and nationalities. A special place is occupied by the Scythiansamong the numerous tribes and peoples that lived in the Crimea hundreds and thousands of years ago,, who in th VII BC. - III century ofour eraplayed a major role in the historical fate of the south of the European part of our country.

The purpose of the study.

This article deals with issues related to the life and culture of the Scythians and analyses the art of the Scythian. The main method of given study is theoretical one.

The main part.

The whole culture of the Scythians, their life, their way of life is literally saturated with military affairs. Warriors in the Scythian society were not only men, but also most women.

The main branch of the economy of the Scythians was cattle breeding. The Scythians roamed in large groups. The dwellings of the nomadic Scythians were felt rooms on a wagon with four or six wheels. Wagons, protecting from wind, rain and snow, were intended for women and small children; they also kept property [3, p.12-13]. Kibitka was used at any time of the year. And where there were vast pastures and the Scythians could linger for a long time next to them, semi-dugouts were built. The Scythians went deep into the ground by about half their height, then they put a hut over the pit.

Ground "steps" inside the dwelling were insulated with grass mats, felt was placed on top, so comfortable beds were obtained that replaced the beds. In the same "steps" recesses were made on the side and food, dishes, and things were placed in the resulting "chamber". There were some kinds of "lockers". In the center of such a dwelling there was a hearth, a hole was made to let the smoke go up, in addition, the entrance canopy was wide open, the smoke was quickly blown out by a draft.

Clothing and equipment of the Scythians was well adapted to the conditions of nomadic life [4, p. 34]. Various products made of leather, skins, felt and wool took a large place in their everyday life [4, p. 35]. These materials were used to make clothes, shoes, wineskins and many other household items. They were mainly made by women. The clothes of the Scythians were very comfortable - short, tight-fitting leather (with fur inside) caftans, tight-fitting leather pants or wide woolen harem pants, soft ankle boots (Scythians) tied at the ankle, pointed hoods that protected the head well [4, p.35]. The clothes were decorated with embroidery, and the ceremonial clothes of rich Scythians were embroidered with many gold ornaments. The Scythians dressed in leather, linen, wool and fur clothes.

Costumes for both women and men were same. The men's costume consisted of a leather sleeveless jacket - a shell, the sleeves of a soft shirt came out of it, the pants fell to the ankle, where they ended over soft leather half boots without heels, covered with a belt at the same ankle. Women's costume is a long pleated dress. On the head is often a soft veil, falling to the waist.

The dishes used in the nomadic life of the Scythians were mostly wooden and metal: bronze cauldrons for cooking meat, bronze bowls, wooden trays and bowls. Scythian ceramics is made without the help of a potter's wheel.Scythian boilers are flat-bottomed and varied in shape. Scythian bronze cauldrons up to a meter high, which had a long and thin leg and two vertical handles, were widely used.

The Scythians ate, most likely, twice a day. A light breakfast in the morning, from stocks of cheese or dried meat, in the summer they ate berries picked by women. The main meal was in the evening. From lunch they began to cook pieces of meat, koumiss, milk vodka or wine were served with it. It is assumed that the Scythians could eat porridge from millet, barley, grinding the grains and then pouring boiling milk over them. On campaigns, the Scythian warriors were content with dried meat, dry cheese (everyone had all this in cloth bags with them) and what they plundered.

Scythian art is well known mainly from objects from burials. Most household items made of metal, bone, and also, obviously, wood, fabrics, felt and leather were artistically designed with a certain originality. The motifs of such design were borrowed from the zoomorphic world and were embodied in the images of figurines or some parts of animals, birds or fish [1, p. 60]. This type of fine applied art was called the Scythian animal style. Among the images of early Scythian art, the favorite were images of a deer, a ram, a panther, an elk, a mountain goat. The motifs of the heads of a horse, an eagle, a vulture ram were often used. Most often, animals were depicted in a calm state [1, p.60]. In the future the Scythian style loses its peculiarity under the influence of Greek art. At the same time, realistic scenes are gaining popularity - scenes of the struggle and torment of animals and images of various animals. Images in the animal style not only met the aesthetic tastes of the Scythians, but also embodied a certain magical symbolism. They played the role of amulets - charms, designed to protect their owners from hostile forces and attract the protection and help of benevolent gods. There is no doubt that weapons, foundries, blacksmiths, jewelry and other workshops existed in the nomads of the Scythians. Their products are widely represented in a diverse composition of objects of Scythian material culture. However, the craft was of the nature of home production. The art of the animal style, formed on the basis of a synthesis of ancient Iranian ideas about the world and ancient Eastern iconography, has

become the most striking and original phenomenon of Scythian culture [5]. The Scythian culture was more widespread than the area of settlement of the Scythians. The influence of the Scythian way of life on the neighboring tribes was enormous. In addition to the animal style, forms of Scythian weapons, some tools and a number of decorations penetrated to the neighbors [1, p.61]. But there are also significant differences, which are reflected in the form of dwellings and settlements, in the form of burial structures, in funeral rites, and in ceramics. So, the face of the Scythian culture is determined by the triad: the characteristic type of weapons, horse harness and the art of the animal style. To this triad, some scientists now add two more signs: bronze cast cauldrons on a conical leg and bronze disc-shaped mirrors with a handle in the form of two vertical columns.

Scythian history occupies a prominent place in the study of the general historical process as a whole. However, the study of culture makes it difficult for the Scythians to have no written language. This, accordingly, makes the main carrier of culture, language, inaccessible to understanding and research. The success of the Scythians in the development of the economy (crafts, agriculture), as well as their culture and civilization, had a significant impact on the history and culture of the subsequent peoples of the South of Russia [2].

In conclusion, it should be noted that the Scythians left an indelible imprint on history. Until now, the history of this people, their appearance and subsequent "disappearance", the roots of their culture and the social prerequisites for statehood remain unclear. However, more and more new historical discoveries make the history of the Scythian tribes more clear and understandable, opening new events of history.

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UDC 55.01.09 EXPERIMENTAL VAZ-E2121: HISTORY OF MECHANICAL ENGINEERING

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Аннотация. Цель статьи - рассмотреть достоинства модели Нива ВАЗ-2121, стилистически оригинальные и сочетающие в себе качества, которые могут быть перспективными в современном машиностроении. Особенное для того времени сочетание проходимости и несущего кузова было уникальным во времена Советского Союза.Именно этот автомобиль положил начало многим иномаркам эданноймодели.

Ключевые слова: машиностроение, история, автомобиль, Нива, ВАЗ-2121, двигатель 1,6 л, проходимость.

Annotation. The purpose of the article is to consider profs of Niva VAZ-2121 model with stylistically original and combining qualities that could be perspective in modern mechanical engineering. The combination of crosscountry capacity and load-bearing body, special for that time, was unique in the days of the Soviet Union. It was this car that laid the foundation for many foreign cars of this class,

Keywords: mechanical engineering, history, vehicle, Niva, VAZ-2121, 1.6-liter engine, cross-country capacity.

Introduction.Niva VAZ-2121 is one of the most interesting Soviet cars in history. Structurally and stylistically original and combining qualities that no other compact model in the world had in this class in those years. Since 1977, more than 2 million cars have been produced, and the demand for the Niva is still there.

Niva's engineers, of course, could not have predicted that the car would find buyers even more than four decades after the start of production.

The relevance of this study is considering profs of this car model with stylistically original and combining qualities that could be perspective in modern mechanical engineering. It is important to explore and find out how the car was created, which is still on the assembly line and is very popular nowadays. Being one of the leaders in sales, this car goes back to the 1970s, when Soviet engineers created the world's first SUV with a monocoque body,

and not a frame, as it was before, thereby laying the foundation for a new branch in the automotive industry.

The main part. The model of this type became the sales leader both in the USSR and abroad immediately after its release. The car was preferred by many hunters and fishermen, farmers, as well as people living in rural areas. Soviet engineers put a lot of modifications into this model. People really liked a combination of cross-country ability and a load-bearing body, unique for that time [2].

Immediately after the release, the model of this type became the sales leader both in the USSR and abroad. The car fell in love with hunters and fishermen, farmers, as well as people living in rural areas. Soviet engineers have invested in this model a lot of danced modifications. The combination of cross-countrycapacity and a load-bearing body, unique for that time, really liked people.

It was this car that laid the foundation for many foreign cars of this class, later popularly referred to as "SUVs", such cars are called crossovers. Today, the Niva is sold at home and to friendly countries, while remaining one of the cheapest SUVs. This car is used both for movement within the city and outside the city. To date, there is a huge number of different types of tuning, both to improve off-road performance and for expeditions [1].

It all started back in 1970, when the Chairman of the Council of Ministers of the USSR Alexei Kosygin, within the framework of the program of "blurring the line between city and countryside", set the teams of VAZ, AZLK and Izhmash to create a comfortable SUV for rural residents.

The first experimental VAZ-E2121 was released in 1971. Moreover, its appearance was very far from what we have become accustomed to for forty years. In fact, it was a chassis with the simplest plumage, on which the concept of a new car was worked out - the SUV did not have a frame, which at that time was considered an unheard-of design audacity. Initially, it was planned to equip the car with a powerful diesel engine, final drives, a rear torsion bar suspension and even a tire pressure control system, but later it was decided to create a simpler version with a high degree of unification with the models already produced by AvtoVAZ, which was economically justified. This prototype allowed the design bureau led by Peter Prusov to significantly reduce the time it took to create a car. Will a 1.6-liter engine be enough, is the box reliable enough, does the car need a center differential lock and downshifts? The answers to all these questions were obtained precisely due to VAZ-E2121.

It is interesting that the tests of the car were carried out in the strictest secrecy, and the factory workers answered the questions of those interested that they were testing a new Romanian SUV.

In a look close to serial, the VAZ-2121 appeared in 1972. The artist Valery Semushkin worked on the design of the new car. The car, according to the designer, was supposed to suit the residents of both the city and the village. It should have felt equally comfortable as a collective farmer, carrying their products to the city market, and a worker who decided to go for mushrooms in the forest. And since, according to the terms of reference, the car was supposed to have a relatively small trunk, the spare wheel, in order to save space, was located in the engine compartment. Then it was not considered aesthetically allowable to place the spare wheel on a remote bracket behind the rear door [5]. In 1973, the VAZ-2E2121, which already looked almost like the well-known Niva, was sent on a test run in Central Asia, after which it acquired a headlight cleaner and a rear wiper. An achometer appeared on the instrument panel, which allowed the driver to monitor the speed when driving on a lower transmission range [4, 6].

In 1974, the car was put up for state tests and in the same year received its own name "Niva", which was patented.

It is interesting that at that time there was noInterstate standard for testing this type of car. After all, the conventional scheme for testing off-road vehicles for the Niva was too severe, and the passenger one, on the contrary ... As a result, they decided to combine both programs, taking into account the versatility of the car. According to the test results, the car received recommendations for mass production and export. True, before getting on the conveyor, the car received some more improvements. So, the rear "triple" lights were replaced with "six", from the "six" they took the headlights.

The chrome bumper gave way to aluminum. There was a second exterior rear-view mirror. The first pilot batch of cars in the amount of 50 units was sent to the regions for controlled operation. Representatives of the plant constantly supervised their new product, which made it possible to identify a few more problems that were eliminated by April 1977, and Niva got on the conveyor.

In addition to selling at home, Niva was actively promoted in foreign markets.

"In 1977, when the serial production of the Niva VAZ-2121 started, it stunned consumers with an unprecedented combination of a comfortable interior, dynamics, very decent handling and at the same time, cross-country ability, quite comparable to the domestic SUVs UAZ and LuAZ known at that time. All this made an impression on foreign buyers as well. VAZ-2121 has become one of the most successful domestic cars in the history of the USSR, sold abroad, including on the markets of capitalist countries spoiled by a variety of markets" [4, www].

For forty years, more than 500 thousand off-road vehicles have been sent abroad. Unpretentious, but at the same time quite comfortable SUV

attracted buyers in more than 100 countries around the world. Importers actively re-equipped the car, making it pickups, convertibles, styling it in fashion. In addition, the assembly of the model was established in Brazil, Greece, Canada, Panama, Chile, Ecuador. The Niva was exported even to Japan, becoming the only Soviet car officially sold in this country. By the way, the Japanese, paying tribute to the general designer of the Niva, in 1986 presented Petr Prusov with a brochure for their future SuzukiVitara with the inscription "To the Godfather of this car".

"The complex transfer gearbox, which was on the first prototypes, was abandoned, since the condition set for the designers of the VAZ-2121 was the preservation of the serial four-speed gearbox – only with modified gear ratios (3.67 / 2.1 / 1.36 / 1.0). The transfer gearbox (low gear – 2.135) was connected to the gearbox with an intermediate shaft. It was not possible to defeat the associated vibrations and noise to the end "[4, www].

In 1978, the VAZ-2121 was awarded a gold medal and recognized as the best car in its class at the international exhibition in Brno. A lot on account of "Niva" and records. So, in 1998, the Niva climbed Everest on its own, to a height of 5200 meters, in the same year, being dropped with a parachute, it ended up in the Arctic and reached the North Pole on its own, and the very next year climbed into the Himalayas to a height of 7260 meters. It was on Fujiyama. The reliability of the car is also evidenced by the fact that the production car was able to work without serious breakdowns for 15 years in Antarctica at the Bellingshausen station.

Conclusion. The Niva also has a lot of sporting achievements: multiple participation in the Paris-Dakar rally, the Atlas rally, the Cameroon Rally and other merits.

In 2001, the history of the VAZ-2121 as a "Niva" ended. JV GM-AvtoVAZ became the owner of the exclusive license for the Niva trademark. But the history of the car itself continues under the name LADA 4X4 and its history can contributed toenhancementof new models in the course of mechanical engineering development.

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FAMILY AND ANCESTRAL MEMORY AS A SPIRITUAL CONTINUITY OF GENERATIONS

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Аннотация.Данная статья посвящена не просто воссозданию фактов семейной истории, истории жизни дедушки автора, она отражает духовную – ценностно-смысловую – преемственность поколений. История жизни Владимира Ивановича Симоненко, выпускника Черноморского высшего военно-морского училища имени П.С. Нахимова, заслуженного изобретателя СССР является мощным нравственным ориентиром для близких людей, источником поистине бесценного жизненного опыта, знаний и беспримерного служения Родине.

Ключевые слова: семейно-родовая память, духовная связь поколений, нравственные ориентиры.

Annotation. This article is dedicated not just to recreating the facts of family history, the life story of the author's grandfather, it reflects the spiritual – value-semantic – continuity of generations. The life story of Vladimir IvanovichSimonenko, a graduate of the Black Sea Higher Naval School, Honored Inventor of the USSR is a powerful moral guide for loved ones, a source of truly invaluable life experience, knowledge and unparalleled service to the Motherland.

Keywords: family and ancestral memory, spiritual connection of generations, moral guidelines.

Introduction. In difficult modern conditions, when the collective West is trying to belittle the greatest spiritual culture of Russia, to turn our people into ivans who do not remember their kinship, do not know their history, culture, indifferent to their roots, turning to their origins is more relevant than ever. Family and ancestral memory is the basis of a person's moral values, the foundation on which their entire future life is built. Family and ancestral memory is a necessary condition for the cohesion of the kinship union, the formation of an individual's semantic life orientations. Without this memory, self-preservation of both the individual and the nation as a whole is impossible. Our attitude towards the past and previous generations should be grateful – for the fact that they made our existence possible.

The purpose of the article is the life story of Vladimir IvanovichSimonenko, a graduate of the Black Sea Higher Naval School, Honored Inventor of the USSR, beloved grandfather of the author of this article.

The methodological basis of the article is the work of such researchers as: N. M. Karamzin [3], P. A. Florensky [5], N. A. Berdyaev [1], dedicated to the problem of a person's moral values, which are laid in childhood and adolescence in the family. Thus, according to the outstanding Russian historian N. M. Karamzin, "the state needs not only physical, but also moral power for its security" [3].In other words, concern for the welfare of the Motherland and its security begins with the worthy upbringing of a new generation of citizens and patriots of Russia, a generation responsible for the future of Russia, honoring their ancestors, feeling spiritual strength and an indissoluble connection with previous generations.

Such scientists as: V. A. Slastenin, I. F. Isaev, E. N. Shiyanovspeak about the importance of a person's moral culture formation on the basis of family and ancestral memory [4]. In their opinion, the culture of a person's life self-determination, their family relations, the culture of communication, moral culture is associated with a person's awareness of themself as a subject of their own life activity, capable of making decisions and being responsible for them.

The problem of the inseparable connection of a person's life with their family, and therefore with the fate of their native country is revealed in the documentary prose of T. I. Gladkikh [2].

Research methods: analysis and synthesis of sources dedicated to the problem of preserving family and ancestral memory as the basis of moral education, as the spiritual continuity of generations; comparison and generalization of the data obtained.

Presentation of the main material. A part of our cultural code is family and ancestral memory. Family and ancestral memory is, first of all, the living memory of the family, conserved and passed on as a relay from

generation to generation, giving spiritual strength to new generations. In this context, family and ancestral memory acquires a human dimension. As T. I. Gladkikh notes, "we comprehend the past in different ways. And it is good if the history of the native land comes through the history of their kind, their family: then it is somehow warmer, and more expensive, and closer" [2, p. 10].

The value of family and ancestral memory is that it contributes to the self-conservation of a person. P. A. Florensky considers the genus as a single whole, designed to fulfill the vital tasks of each person: "The genus is a whole, not the sum of successive generations ... who has no genus, he has no Homeland" [5, p. 419, 421]. It should be added here that the value center of each person's worldview is formed by a system of spiritual and material values accumulated, conserved and passed on as a relay race in the family from generation to generation. Thanks to this, an indissoluble line of historical and value-semantic continuity is being built between past and present generations, between the generation of our grandparents and the generation of grandchildren. In our opinion, it is unthinkable to build a future without relying on family values and the unique experience of our grandparents. After all, to know where to go, you need to know where you came from.

The passing away of my grandfather, Vladimir IvanovichSimonenko, in last May made me once again comprehend that family is the most important thing in any person's life, connected not only with the awareness of their inseparability from their blood relatives, living and experiencing happy and tragic days with them, but also with a feeling of immense gratitude for what we possess and what we have achieved in this life.

My grandfather was born in 1944 on February 1, in the city of Obluchye of the EAO. His parents were railway officers who organized the delivery of weapons to the front during the Great Patriotic war. After the war, they received a new assignment and moved to Zaporozhye. Grandfather was fond of radio engineering from the fifth grade: he divided the boards and soldered them; assembled radios and came up with various adaptations to them. Passion for radio engineering, creative thinking helped grandfather in his studies, and then in the service.

In 1963, grandfather entered the Black Sea Higher Naval School. At that time, all cadets who entered the school had to serve their candidate's experience. Therefore, from 1963 to 1964, grandfather served as a sailor on the ship. Then he studied in the aviation class for five years. He was the foreman of the class. Purposeful and disciplined, he always took a responsible attitude to study, to the fulfillment of tasks. In 1968, my grandfather graduated from school with a red diploma, received the rank of lieutenant and blue shoulder straps. My grandfather received the distribution to Moscow. During his service, he worked on a dissertation research.

My grandfather is the author of many inventions and innovation proposals. The results of his work were successfully applied in the Navy. The family has conserved the state awards which my grandfather was awarded for many years of service to the Motherland, including the badge "Inventor of the USSR". After retiring with the rank of captain of the second rank, grandfather worked in the Moscow region in the military-patriotic camp Patriot. In 2020, he returned to Sevastopol.

A year is coming, as he is not with us. The pain of loss does not subside. It is just that we all learn to live with it, as, probably, all people do when they lose loved ones.

Vladimir Ivanovich was an inventor and innovator, an excellent student and the soul of the company in the division, a good officer and sailor. But for my brother and me, he was the best grandfather in the world.

Conclusion. We must build our life, our future on a solid foundation, and such a foundation is our roots, our family, which teaches us a deep understanding of what family, Homeland, high morality are; this is our family and ancestral memory as a spiritual continuity of generations. This is the value and strength of the spirit of our people, a force that cannot be overcome by anything, by any weapon.

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UDC 902/904

THERE IS NO SUCH A FAMILY IN RUSSIA, WHERE WOULD NOT THEIR HERO BE REMEMBERED... Alexander Kuznetsov

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Аннотация. Памяти моего прадеда, Героя Великой Отечественной войны, за мужество и героизм на полях сражений дважды награждённого самой главной солдатской наградой – медалью «За Отвагу», посвящена эта публицистическая статья.

Ключевые слова: Герой Великой Отечественной войны, медаль «За Отвагу».

Annotation. This journalistic article is dedicated to the memory of my great-grandfather, the Hero of the Great Patriotic War, who was twice awarded the most important soldier's award – the medal "For Bravery" for courage and heroism on the battlefields.

Keywords: Hero of the Great Patriotic War, the medal "For Bravery".

Introduction. The bloody war which began in June 1941 turned the life of the entire Soviet people upside down. For all nations and nationalities, for all strata of society, for every citizen, it has become a truly Patriotic, holy war. Despite the fact that decades have passed since the end of the war, every new generation entering life rethinks the heroic and tragic pages of the Great Patriotic War, pays tribute with a sense of gratitude to the immortal feat of the victorious people. Perhaps there is no such family in our vast country which was not scorched by the fire of that war. Each of those people who heroically fulfilled their duty to protect our Motherland both at the front and in the rear during the difficult time of the war with fascist Germany has the right to be immortalized in the history of Russia.

The purpose of the article is a story about one of these Heroes, my great-grandfather, Chernykh June Kirillovich, a participant of the Great Patriotic War, who received his first medal *For Courage* 77 years after being awarded this award – for the battle of the Baltic Shauliai in 1944.

Presentation of the main material. My great-grandfather was born on June 21, 1925 in the village of Dubrovka, Tomsk region. When the war began, he was barely 16 years old. Great-grandfather was called to the front in summer of 1943. As part of the First Baltic Front with heavy fighting, he passed through the whole of Belarus, liberated the city of Riga. For the courage and heroism shown on the battlefield, June Kirillovich was presented with an award – the medal *For Courage*. However, he did not receive a medal because in 1944, near Shauliai, he was seriously wounded in his leg, was operated on in a field hospital, and then sent for further treatment to

Sverdlovsk (now Yekaterinburg). In that battle, his platoon leader was killed, a comrade was wounded, the award documents were lost. Four months after being treated for an injury, June Kirillovich was sent to the eastern front - to the Far East where he fought against imperialist Japan. The war for my greatgrandfather, then a corporal of the Guard, ended in Port Arthur. He returned home only in 1949. For the courage and heroism shown in the battles with the Japanese, June Kirillovich was awarded the second medal For Courage, as well as a Certificate of Honor from the command of the Far Eastern Army which says: "There have been many hard trials on your combat path. Our banners are covered with the glory of front-line victories, there is a share of your military labor in this. Together with your fellow soldiers, you participated in campaigns through the arid deserts of Mongolia, the mountain passes of the Great Khingan, through the whole of Manchuria and brought our banner, sacred to the Russian heart, to the city of Port Arthur. We express our gratitude to you for your service to the Motherland, and continue to keep the honor and dignity of the invincible Stalinist army. Be faithful to the banner of Lenin-Stalin which led us to Victory. We hope that on the fronts of peaceful labor you will not lose the honor of the Stalinist army soldier ... ".

And in the peaceful post-war period, June Kirillovich actively helped in the restoration of Russia, he worked for more than 40 years as a builder. He went from an ordinary builder to a foreman. The district center where he lived was almost completely rebuilt with his participation. For outstanding services during the restoration of Russia, he was awarded the Order of the Labor Red Banner. But my great-grandfather did not receive his first medal *For Courage* – for that battle near the Baltic Shauliai.

When I found out about it, I decided to help my heroic great-grandfather get a well-deserved award. I collected all the necessary documents and sent them to the Central Archive. Now the day of April 30, 2021 is a special day for my family. It was that day when the Commander of the Central Military District, Colonel-General Lapin Alexander Pavlovich, congratulated my great-grandfather, Chernykh June Kirillovich with a high award via video link (then restrictions were imposed due to the coronavirus), and the military commissar for the Tomsk region handed over an expensive and so longawaited for my great-grandfather and our whole family medal *For Courage*, the most significant soldier's award.

I am glad that my great-grandfather received his well-deserved medal *For Bravery* during his lifetime. He died early in the morning on November 7, 2021. He was always proud that I, his great-grandson, chose the profession of defending the Motherland.



Conclusion. War always requires a huge strain on the forces and resources of the state, the entire people, and subjects people's consciousness to the most serious test. The victory in the Great Patriotic War is not only a historical date, it is, first of all, a reminder of the price paid by our great-grandfathers and great-grandmothers for our happiness to be born and live in our great country. The lines from Robert Rozhdestvensky's famous poem *Requiem* sound like a testament:

...People! As long as hearts are pounding, remember! At what price happiness was won – please remember!..

We remember, and we will tell our children about our glorious Heroes, so that they also remember because there is a glory that will not be forgotten, and there is a memory that will not end.

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PATRIOTISM AS A STRONG MORAL TRADITION OF THE RUSSIAN MILITARY

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Аннотация. В статье рассматривается феномен патриотизма на примере героизма, проявленного и проявляемогороссийскими воинами в ходе Специальной военной операции. Патриотизм всегда находит воплощение в чувстве воинского долга перед Отечеством. Обосновано, что за долгую историю России героизм её сынов и дочерей обрёл силу прочной нравственной традиции, стал нормой героического поведения для российских военных. Подчёркивается, что в основе этого героизма – любовь к Отечеству и преданность ему.

Ключевые слова: патриотизм, Отечество, героизм российских воинов, Специальная военная операция.

Annotation. The article deals with the problem of patriotism on the example of Russian soldiers' heroism manifested hourly during a special military operation. Patriotism is always embodied in a sense of military duty to the Fatherland. Over the long history of Russia, the heroism of its sons and daughters has gained the strength of a strong moral tradition, has become the norm of heroic behavior for the Russian military. At the heart of this heroism is love for the Fatherland and devotion to it.

Keywords: patriotism, Fatherland, heroism of Russian soldiers, Special military operation.

Introduction. At present, when the collective West is trying to divide the Russian people, eradicate historical memory from their consciousness, level the role of the Soviet Union in the victory over German fascism, belittle the spiritual culture of our people and replace traditional moral values by imposing norms and rules of life alien to us, the problem of the need to preserve our historical memory, the formation of a high patriotic consciousness, readiness for worthy service to the Fatherland and fulfillment of civic duty to protect the native land. Therefore, the need for the revival of patriotism as a fundamental value of every person, a citizen of their Fatherland is a primary task in modern socio-cultural realities. As our President Vladimir Putin said, "we must build our future on a solid foundation. And such a foundation is patriotism. This is respect for our history and traditions, the spiritual values of our peoples, our millennial culture and the unique experience of coexistence of hundreds of peoples and languages on the territory of Russia" [2].

The greatest trials which our compatriots have endured with honor at all times when they stood up to defend their native land will forever remain in our memory. Their immortal feat will always serve as an inspiring example of patriotism for all future generations, primarily because they defended their right to life, to the existence of an independent nation with their inherent statehood, their history and distinctive culture.

We are rightfully proud of our contemporaries, participants in a Special military operation, who, like their glorious predecessors, heroically defend the right to live guided by the spiritual and moral values established by our ancestors: to live on their own land, to speak their own language.

The purpose of the article is to consider the problem of patriotism as a moral tradition of the Russian military on the example of heroism shown by Russian soldiers during a Special military operation.

The methodological basis of the study is represented by the works of such scientists as: M.N. Khromova [9], I.Y. Lapin, S.Y. Kargapoltsev [7], G.V. Zaridze[4], A.L. Zhuravlev and A.V. Yurevich [3]. Considering the problem of patriotism, they define this phenomenon as a feeling of love for the Fatherland, a willingness to benefit it; identification with their country, its history, culture and people.

The problem of patriotism has always been in the focus of attention of researchers, including N.M. Karamzin [6], V.G. Belinsky [1], N.G. Chernyshevsky [10], A.N. Radishchev [8]. Thus, V.G. Belinsky has repeatedly noted in his works that patriotism must be proved not by word, but by deed. According to N.G. Chernyshevsky, only a person with a low soul can change his homeland because a true "patriot is a person serving the homeland, and the homeland is, first of all, the people" [10, p. 474].

In the course of the research, the following **theoretical methods** were used: analysis of the literature on the designated problem, comparison, generalization and classification of the data obtained.

Results and Discussion. The word 'patriotism' from the Latin 'patria' translates as 'fatherland' which means the national unity of a person with the past, present and future of their country. In the Russian language, this term appeared thanks to Peter the Great, who focused attention on the military aspect of patriotism. Subsequently, the interpretation of patriotism began to be associated with a sense of pride for their country, their people. L.N. Tolstoy puts something more into the concept of patriotism than love for their country: "Patriotism is an awareness of one's own inseparability from the Homeland and an integral experience with it of its happy and unhappy days" [5, p. 10].

In the days of severe trials for a country, the sense of patriotism is actualized and is a kind of moral guideline for citizens, not allowing them to stay away from the struggle to protect national interests. War, as history shows, requires the greatest exertion of forces and huge sacrifices on a national scale from the people, reveals the ability of ordinary people to self-sacrifice and heroism in the name of Victory, in the name of freedom and independence of the Fatherland. This was the case during the Great Patriotic War, and it is happening now – during a Special military operation.

Now another dramatic page of the history of Russia is being written with the blood and lives of Russian soldiers. Our boys and girls have had hardships no less severe than our people got during the harsh years of the Great Patriotic War. They courageously and courageously defend the security, national ideals and interests of the Russian population of Ukraine. Every day since the beginning of the Special military operation, we are witnessing new examples of the bravery and courage of our soldiers, their selfless service to the Fatherland. The need to learn more about the heroic everyday life of our guys during a Special military operation led to the idea of creating an Anthology of the feat of Russian soldiers. Thus, the following data were collected:

Sergeant Alexey Alekseev



Sergeant Alexey Alekseev, during the ammunition overload, discovered a low-flying unmanned aerial vehicle which was conducting reconnaissance of the division's positions. The serviceman immediately informed the division commander and nearby posts about this. The unmanned aerial vehicle was destroyed thanks to the sergeant's reaction. The division was able to avoid an

enemystrike, changed positions and continued to perform tasks to hold

defensive lines

Corporal ArtemiyArtyunin



From the first days of the Special military operation, corporalArtemiyArtyunin, in order to ensure uninterrupted logistical support for Russian units, repeatedly carried out the delivery of material and technical equipment to the Airborne troops group on the contact line with the nationalist forces. On that day, Ukrainian nationalists

attempted to destroy a Russian automobile convoy following the front line. The car moving ahead of Artemy's car was severely damaged by an artillery shell that exploded near it, lost its course, blocking the movement of the column in a difficult section. Having assessed the situation, Artemiy drove around the damaged car on the side of the road, and risking his life, pulled 3 injured crew members out of it and transferred them to his car, where he provided them with emergency medical care. Then he took the damaged car in tow and delivered it to the destination. The bold and decisive actions of corporal Artyunin made it possible to save the lives of wounded soldiers, as well as to prevent the seizure of missile defense.



Junior SergeantAlexander Valeev

The department under the command of junior sergeant Alexander Valeev from the first days of the Special military operation carried out combat missions to detect, escort and promptly transmit information about the air targets of Ukrainian militants to the command post of theRussian airborne troops. During the execution of the combat mission to cover the command post of the Russian Armed

Forces from enemy air strikes, during the advance and occupation of the

designated line, Kiev militants tried to destroy columns of Russian equipment. Junior sergeant Valeev's unit was hit by Ukrainian neo-Nazis who used multiple rocket launchers 'Grad'.Being under enemy fire, junior sergeant Valeev, acting confidently and decisively, began to give commands to the driver-mechanic to perform the maneuver. Thanks to the competent actions of Alexander Valeev, the car was taken out from under the impact, the management of the department by means of communications was preserved, while junior sergeant Valeev did not weaken the observation of the air situation. In addition, the selfless actions of Junior Sergeant Alexander Valeev ensured the continuous combat operation of the Strela-10 selfpropelled anti-aircraft missile system. This made it possible to detect an enemy drone in a timely manner, from which the enemy corrected artillery fire on the Russian unit. Having found an aerial target, Valeev gave the command to the gunner-operator to destroy it. After the elimination of the enemy drone, the artillery shelling was stopped. Thus, it was possible to avoid losses among the personnel, weapons and military equipment of the Russian troops.

Sergeant VasilyVerkhushkin

Sergeant VasilyVerkhushkin, together with his subordinates, carried out the task of protecting the storage sites of property and ammunition of the airborne division battalion tactical group. At night, Vasily, while monitoring the surrounding area, discovered an approaching sabotage and reconnaissance group of the enemy numbering 19 nationalists, armed with small arms and grenade launchers. During the battle, sergeant Verkhushkin received a shrapnel wound from a grenade that exploded near him, but despite this, he courageously continued to constrain the enemy's actions until reinforcements arrived.

Senior Warrant Officer Igor Voynov



Senior warrant officer Igor Voynov, as part of engineering units, carried out the task of clearing the terrain, searching for explosive objects on the territory of settlements liberated from Ukrainian nationalists. During the demining of the area of one of the settlements, Igor discovered a detachment of nationalists. Having instantly assessed the situation, Igor reported to the command about the upcoming



provocation, and then, using the terrain, together with other servicemen, took up positions and prepared to give battle to the enemy. A group of nationalists, trying to regroup to repel the attack of Russian engineers, suffered heavy losses and was forced to retreat, abandoning weapons and ammunition. After the battle, Voynov, together with other servicemen, began clearing the road. During mine clearance, Igor personally discovered and defused 8 mines. Thus, thanks to decisive actions, the high level of professional training of seniorwarrant officerVoynov, a group of enemy saboteurs was neutralized, a section of road was cleared which created prerequisites for the liberation of the city from Ukrainian radicals. With his decisive actions and professional training, Igor Voynov ensured the elimination of the sabotage group operating in the territory liberated from the nationalists.

Senior Lieutenant Nikita Galushkin

Under the command of senior lieutenant Nikita Galushkin, Russian gunners destroyed four multiple rocket launchers, six artillery pieces, two command posts and a large number of enemy manpower, stopping his offensive and throwing them back to their original positions. And all this despite the superior forces of the advancing militants and the counter-battery struggle.

LieutenantArtemGladsky

A lieutenant's tank platoon as part of a battalion-tactical group of a motorized rifle regiment was taking control of one of the airfields occupied by Ukrainian nationalists. Being under enemy ATGM fire, ArtemGladsky's crew continued to accurately hit targets and skillfully maneuver on the battlefield. During the battle, lieutenant Gladskypersonally discovered the enemy's firing positions and with return fire destroyed three tanks and two enemy infantry fighting vehicles, as well as a large number of Ukrainian nationalists.

Corporal Vladimir Golubchikov

During the special military operation to protect the Luhansk and Donetsk People's Republics, corporal Vladimir Golubchikov repeatedly removed equipment from under enemy artillery fire, skillfully organized timely repairs and maintained weapons in good condition. Vladimir, as part of a column, was marching to one of the settlements liberated from

the nationalists with the task of securing a foothold for its protection and defense. Moving along the given route, Golubchikov found a group of nationalists preparing an ambush on the route of the column. Without waiting for the command, Vladimir instantly got his bearings in the situation and, having maneuvered in a car, took an advantageous position, after which he opened fire from small arms at the nationalists. As a result of accurate shooting, a group of nationalists was liquidated. During the inspection of the enemy's positions, maps with mining areas marked on them were found. Thanks to the competent actions of corporal Vladimir Golubchikov, the provocation against the column of Russian troops was stopped.



Corporal Sergey Devushkin



Corporal Sergey Devushkin, as part of a battaliontactical group, carried out a combat mission to liberate a settlement from Ukrainian nationalists. The car which was driven by Sergey came under oncoming fire from the enemy offering fierce resistance. Skillfully maneuvering, Sergey selflessly covered the comrades leading the battle with the car,

after which, getting out of the car, he fired at the nationalists.Thanks to Devushkin's efforts, the servicemen managed to hold the line until reinforcements arrived, after which the Russian paratroopers went on the offensive and destroyed a group of Ukrainian militants.

Ensign Ekaterina Ivanova



The paramedic of the surgical department, Ensign Ekaterina Ivanova, from the first day of the Special military operation selflessly provided assistance to wounded soldiers and commanders.

In one of the clashes of our units with Ukrainian nationalists, Ekaterina, not sparing herself, carried out the

wounded from the battlefield. Having gathered a group of the wounded, Ekaterina Ivanova began to evacuate them to the hospital. On the way, the ambulance was subjected to mortar fire from neo-Nazis. One of the enemy shells exploded next to the car. Ensign Ivanova, not sparing her life, showing courage and bravery, covered a seriously wounded serviceman who could not hide from enemy fire on his own. Thanks to the selfless act of Ekaterina Ivanova, the life of the wounded serviceman was saved. Ekaterina herself received a shrapnel wound. The ambulance reached the hospital in a timely manner, where all the wounded were treated.

Corporal Dmitry Kaurdakov



During the offensive of the Ukrainian nationalists, corporal Dmitry Kaurdakov held positions in the area of one of the settlements as part of the battalion-tactical group of the motorized rifle brigade. Being in an equipped shelter, he conducted targeted fire on the advancing enemy. After another artillery strike, he noticed that some

of the servicemen had received shrapnel wounds. Despite the continuous shelling of the nationalists, corporal Kaurdakov, showing courage, got out of hiding, crawled to the wounded and dragged them to a safe place on himself. There he provided them with first aid, he continued his combat mission, destroying the enemy and protecting his comrades. The courage and professionalism of corporal Dmitry Kaurdakov made it possible to repel the enemy's attack, as well as minimize losses and save the lives of the personnel of the battalion tactical group.



Junior Sergeant of the Medical Service Anastasia Kashkurova

Junior sergeant of the medical service Anastasia Kashkurova, acting as part of the medical detachment of the airborne division, has been participating in a special military operation since the first days. She repeatedly, risking her own life, provided highly qualified emergency assistance to servicemen and civilians. One day, a Russian

battalion tactical group defended an important strategic object previously recaptured from the enemy. The militants, seeking to regain control of the lost positions, launched a counteroffensive, opening artillery fire at the same time. Some of the shells fired by the enemy hit the medical center, where at that moment Anastasia Kashkurova was providing medical assistance to servicemen. Despite this, the nurse did not lose her head and, under continuous shelling, risking her own life, carried the wounded out of the danger zone, which saved their lives.

Corporal Kristina Kim



During the special military operation to protect the Donetsk and Luhansk People's Republics, Corporal Kristina Kim repeatedly, timely and at a high professional level, provided emergency medical care to servicemen of the airborne division. In the battle with the Ukrainian nationalists, Kristina Kim, being under heavy enemy fire,

showing courage and dedication, provided first aid to twelve wounded paratroopers, after which she personally took them out from under fire and grouped them in a safe place which saved their lives. After the end of the battle, she ensured the evacuation of all the wounded to the field medical detachment.Kristina Kim also provided medical assistance to civilians. Corporal Kim saved the life of a four-year-old boy who was wounded after militants fired at a car with civilians from a heavy machine gun. After timely emergency medical care, the child, who is in stable condition, was successfully taken to the nearest hospital.



Senior Lieutenant Anton Kiselyov

A tank platoon under the command of senior lieutenant Anton Kiselyov as part of an assault group of the Russian Armed Forces took a direct part in the liberation of one of the settlements from the control of Ukrainian nationalists. Immediately wedged into the enemy's defense, Anton

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Kiselyov's platoon met fierce resistance from the nationalists. During the battle with superior enemy forces, Anton's tank was blown up by a mine and fired from a hand-held anti-tank grenade launcher. Anton Kiselyov, despite the concussion, showing courage and bravery, continued to fight with small arms, while personally destroying the grenade launcher. Continuing the fight, senior lieutenant Kiselyov noticed a damaged infantry fighting vehicle and, risking his own life, personally evacuated the crew members of the transport and gave them first aid.

Senior Warrant OfficerSergey Korsunov

The seniorwarrant officerSergey Korsunov provided uninterrupted communication to the battalion tactical group. One day, the column came under mortar fire, as a result of which a certain amount of equipment was disabled. Sergey Korsunov, under enemy fire, was able to load twelve wounded into his car and evacuate them.

Colonel Alexander Lozhevich

Alexander Lozhevich, having assessed the situation and taking into account the peculiarities of the terrain, competently distributed personnel, weapons and military equipment. Being on the front line, colonel Lozhevich made adjustments to artillery fire, and with the beginning of offensive actions led assault groups.

During the assault on the fortified positions of the Kiev militants, Lozhevich, thanks to his professionalism and competent leadership of his subordinates, successfully stopped all enemy attempts to open and suppress the firing positions of the advancing Ukrainian troops. The combat task was accomplished thanks tocolonel Alexander Lozhevich's courage, heroism, skillful leadership and commanding skills. Ukrainian militants, having suffered significant combat losses, were forced to leave the fortified area they occupied.

Sailor, scout-sniper of the reconnaissance company of the Black Sea Fleet Marine Corps Nikita Maksimenko



Since 2014, Nikita's family has lived in Sevastopol where he finished school №14. After school, Nikita entered the Law Institute of the Sevastopol State University where he enjoyed a well-deserved reputation among fellow students, took an active part in the life of the university, was ready to help all those in need. During his studies at the Law

Institute, such personality traits as: discipline, responsibility, focus on results, the desire to be useful to society and his Fatherland were manifested. After graduating from the institute, Nikita made a decision to dedicate his life to serving the Fatherland. From the first days Nikita Maksimenkoparticipated in a Special military operation.

During this time, he repeatedly saved the lives of his colleagues. So, on May 2, 2022, Nikita rescued an officer who fell overboard of a boat hit by a bayraktar. The next time he carried two wounded men, one of whom had a severe wound to the carotid artery. Nikita managed to stop the bleeding, his



comrade-in-arms waited for evacuation to the hospital a day later and remained alive thanks to Nikita. On May 8, 2022, Nikita Maksimenko, risking his life, took out five more wounded comrades from the battlefield which saved their lives. During the rescue of another wounded colleague, Nikita died. He died the death of the brave. Awarded the Order of Courage (posthumously).

Private Alexey Marin



Private Alexey Marin, as part of a battalion-tactical group of Russian paratroopers, carried out a combat mission to liberate strategically important areas from armed formations of Ukrainian radicals. At night, moving along the route, Alexey found on the side of the road a group of nationalists armed with small arms and a grenade launcher,

preparing an attack on the column. Having instantly oriented himself, Alexey sent the car at full speed at a group of militants which caused panic among the saboteurs and forced them to randomly change positions. With his brave act, Alexey called fire on himself, which made it possible for the main forces of the column to regroup and begin attacking the nationalists. Despite the concussion, Alexey got out of the combat vehicle on his own and continued to attack the nationalists with small arms. As a result of the brave and courageous actions of Private Marin, a group of nationalists numbering up to thirty people was liquidated.



LieutenantDaniel Marshev

Daniel Marshev was born on June 16, 1994 in the Republic of Tatarstan. He graduated from the Black Sea Higher Naval School. He was a reconnaissance group commander of the reconnaissance company. During the Special military operation in Ukraine, he died heroically on May 5, 2022. DaniilMarshev devoted his life to selfless

service to the Fatherland and remained faithful to the military oath until the last day. He will always be an example of courage and bravery for us, loyalty to his duty. Daniel Marshevwas awarded the Order of Courage (posthumously).

Guards Senior Lieutenant StepanMinaev



A group of marines under the command of Guard senior lieutenant StepanMinaev liberated one of the settlements from the armed formations of Ukrainian nationalists. Moving through the settlement, StepanMinaev discovered a fortified enemy point. Having surrounded the building, the Pacific Marines began to storm. StepanMinaev, being at the forefront, skillfully led the unit. During the battle, risking his life, Guard senior lieutenant Minaev personally took out a wounded subordinate from under sniper fire. The Ukrainian nationalists, having suffered heavy losses, laid down their arms and surrendered. When inspecting enemy positions, StepanMinaev found unmanned aerial vehicles, Western-made radio stations, terrain maps, GPS navigators, uniforms, weapons and ammunition in the building. Thanks to the data received from the Guard senior lieutenant Minaev from the discovered maps of the terrain, the positions of the militants were destroyed by artillery fire.

LieutenantMaria Miroshnichenko

Together with colleagues, during the evacuation of wounded soldiers in the village of Chupovka, Maria Miroshnichenko came under fire. Risking her own life, she carried out fighters from under fire. The girl saved the lives of four servicemen. When providing medical care to another fighter, she herself received a serious shrapnel wound, but did not leave the wounded. After the lieutenant of the medical service Maria Miroshnichenkowas sent to the hospital. There, Defense Minister Sergei Shoigu personally presented her with the medal *For Bravery*.



Senior Lieutenant Valery Palamarchuk

Tank platoon commander Valery Palamarchuk replaced the deceased company commander in battle. The crew, commanded by senior lieutenant Valery Palamarchuk, personally destroyed three tanks, infantry fighting vehicles and up to thirty people on August 9, 2022. Due to a serious

injury, Valery died. His widow told: "Our children will bear father's surname with honor and pride". The commander of the Baltic Fleet, vice admiral Viktor Liina, presented the Hero of Russia star to the widow of Senior Lieutenant Valery Palamarchuk.



Deputy Commander of the Black Sea Fleet1st Rank Captain Andrey Paly

AndreyNikolaevichwasbornonFebruary 13, 1971 inKiev. In 1992 he graduated from the Kiev Higher Naval Political School with a degree in Social Psychology. After graduating with the rank of lieutenant, he served in the National Guard of Ukraine in Kiev. However, in March 1993, due to his refusal to take the oath of the Ukrainian

army, he left for the Northern Fleet. In August 2004, Paliy returned to the Black Sea Fleet. He was deputy commander of the large anti-submarine ship



Ochakov, then deputy commander of a part of the Black Sea Fleet landing ships for educational work, head of the department for work with the personnel of the Black Sea Fleet of the Russian Federation. He took part in military events in Georgia, in Syria. He was Deputy Commander of the Russian Armed Forces in Syria. Participant of long-distance sea voyages. Andrey Nikolaevich Paliy served as Deputy Head of the Black Sea Higher Naval School for personnel management from 2014 to 2019. In 2020, he was appointed Deputy Commander of the Black Sea Fleet. Near Mariupol, among other things, Andrei Paliy ensured the functioning of a peaceful corridor for civilians to leave the city. He died on March 19, 2022 during the liberation of Mariupol.

Corporal Tatiana Paramonova

Since the first days of the Special military operation, corporal Tatiana Paramonova has been performing tasks as part of the medical detachment of the airborne division. Agroup of paratroopers, which included corporal Paramonova, liberated one of the settlements from Ukrainian nationalists. Fiercely defending themselves, the Ukrainian radicals responded with massive fire. During the battle, corporal Paramonova, despite the mortar shelling, carried six wounded out from under heavy fire and, loading them onto an ambulance, evacuated them to a field medical detachment, where they received emergency medical care. The courageous and selfless actions of corporal Tatiana Paramonova made it possible to save the lives of wounded servicemen.

CorporalYevgenyPakhomkin



During the offensive of Russian troops on one of the areas, well fortified and held by Ukrainian militants, YevgenyPakhomkin, thanks to his professionalism, promptly and timely detected enemy firing points and his camouflaged positions and transmitted information about them to the command post of the Russian Armed Forces.

In addition, corporal Pakhomkin competently and with high accuracy adjusted the fire of artillery units, and also recorded the defeat of armored vehicles and manpower of Kiev militants after strikes by Russian aviation and artillery.

The intelligence data received from YevgenyPakhomkin allowed the column of Russian armored vehicles to freely overcome the settlement held by the Ukrainian punishers, and to avoid losses of personnel, as well as to preserve equipment and weapons. In addition, YevgenyPakhomkin, conducting reconnaissance with the help of a drone, discovered an enemy command post, which was subsequently successfully eliminated.

Forewoman Galina Pidgurskaya



From the first days of the special military operation to protect the Donetsk and Luhansk People's Republics, foreman Galina Pidgurskaya has repeatedly provided emergency medical care to servicemen of the motorized rifle brigade quickly, in a timely manner and at a high professional level. During the battles with the Ukrainian

nationalists, Galina, being under heavy enemy fire, showing courage and

dedication, provided first aid to twenty wounded soldiers of the brigade right on the battlefield, after which she personally took them out from under fire, grouped them in a safe place and provided disguise, which saved their lives. After the end of the battle, she ensured the evacuation of all the wounded to the field medical detachment.

CaptainAlexander Savchenko



In the area of one of the settlements, an amphibious assault company under the leadership of captain Savchenko, performing a special task, discovered the hidden positions of Ukrainian nationalists. Using the terrain, Alexander Savchenko secretly brought an assault company to the enemy's positions and, taking advantage of surprise, attacked.Having opened targeted fire on the enemy, the

Russian paratroopers destroyed an observation post, a tank, two infantry fighting vehicles, two mortar crews and eighteen nationalists. Also, Russian servicemen found and seized a large number of small arms, grenades and ammunition in enemy positions.

The selfless actions of the Russian paratroopers made it possible to disrupt the upcoming provocations against the Armed Forces of the Russian Federation. At the same time, captain Savchenko's unit completed the combat mission without losses.





Sergei Shoigu awarded the Hero of Russia Star to colonelRustamSaifullin for his courage and heroism. In the conditions of contact with the enemy, RustamSaifullin ensured the performance of engineering tasks in such a way as to save his subordinates as much as possible, and at the same time achieve his goals. He defended the pontoon bridge

across the Seversky Donets. SergeantVelimirTrigub



The assault group which included Sergeant VelimirTrigub carried out tasks to ensure the safe movement of the column of the battalion tactical group of the Russian Armed Forces. Advancing on foot over rough terrain, the group found a stronghold of Ukrainian nationalists. Despite the significant superiority of the enemy in manpower and weapons, the Russian military entered the battle. As a result

of a sudden and fleeting battle, more than twenty nationalists were destroyed by targeted fire from Russian servicemen, seven laid down their weapons and surrendered, and more than seventy Nazis retreated to areas controlled by Ukrainian militants.When the militants tried to recapture the abandoned stronghold as a result of an artillery salvo, VelimirTrigub with five servicemen was cut off from the main forces of the assault group. The nationalists, noticing this, threw their main forces to break through the defense through his area of responsibility.Firing from small arms, sergeantVelimirTrigub continued to bravely hold the occupied stronghold for three hours before the arrival of the main forces of the battalion. Thanks to the courage and determination of sergeantVelimirTrigub, the Ukrainian nationalists lost their stronghold and a large number of manpower and weapons.



Guard Lieutenant PolinaFoteva

Guard lieutenant PolinaFoteva maintained the proper operation of communication lines both within the anti-tank division and between the unit and the higher command. While on the front line, she discovered a Ukrainian tank platoon which was entering the flank of the Russian troops. Having assessed the situation, PolinaFoteva informed the division commander about the actions of the militants and gave him the coordinates of

their positions. After the battle broke out, the Russian signalman corrected artillery fire and recorded the destruction of enemy armored vehicles. Thanks to the professional and timelyGuard lieutenant Foteva's actions, it was possible to detect and destroy two tanks and three armored vehicles of the enemy. The militants, having suffered heavy losses, were forced to retreat.



Senior Lieutenant VadimChebotarev

Senior lieutenant VadimChebotarev was part of a battalion tactical group which secured a foothold in a given area and organized defense. Senior lieutenant Chebotarev's platoon was there. VadimChebotarev was able to quickly place an artillery crew in a firing position and began striking after the Ukrainian nationalists began to cross the water barrier in order to attack Russian servicemen and take

control of the border. As a result of thesenior lieutenant's actions, the enemy's military equipment and manpower were destroyed. The militants suffered significant damage, and they no longer attempted to regain the lost area.

Sergeant GlebChubrik



The unit of sergeantGlebChubrik, acting as part of the battalion-tactical group of the Russian Armed Forces, carried out a combat mission to liberate one of the settlements from the control of Ukrainian nationalists. Moving through the settlement, Gleb found two firing positions of militants in an old abandoned building. Having correctly distributed the efforts of his subordinates, Gleb

organized a surprise attack from hiding. During the clashes, Sergeant Chubrik's squad destroyed more than ten nationalists. At the same time, there were no losses among the military personnel.

The brave and decisive actions of sergeantGlebChubrik, as well as the high professionalism of his subordinates, contributed to the liberation of the settlement from the armed formations of nationalists.

Senior Sergeant Mikhail Chekulaev



Senior sergeant Mikhail Chekulaev, together with his squad, carried out the task of scouting the area near one of the settlements under the control of Ukrainian nationalists. Moving along the route, he found an enemy fortified area and a unit of neo-Nazis numbering more than ten people preparing an ambush for Russian units in the vicinity of the

city. Having correctly distributed the forces of his subordinates, Mikhail Chekulaev decided to suddenly attack the positions of the radicals. While a group of servicemen was firing at the nationalists preparing an ambush, he and the second group went to the rear of the fortified area and inflicted significant damage to the enemy. During the short-lived battle, two enemy firing points and more than ten militants were destroyed.



Sergeant Irina Yushkova

The nurse of the surgical department, sergeant Irina Yushkova, has been performing tasks from the first days of a Special military operation to provide emergency, urgent and planned medical care to servicemen of Russian units who were injured as a result of clashes with Ukrainian nationalists.The rear column which included Irina was

advancing to the line of contact for timely supply of troops.

Ukrainian nationalists attempted to disrupt the material support of Russian units on the front line and attacked the column.As a result of the shelling by armed radicals, the medical support car in which Irina Yushkova was was damaged and lost its course.Being under enemy fire, Irina Yushkova showed composure, quickly oriented herself in a rapidly changing situation and provided emergency medical assistance to nine servicemen who were injured as a result of an artillery salvo, which saved their lives, after which she began to evacuate them. Having loaded the wounded into the armored personnel carrier following, Irina continued to accompany them until they arrived at the field hospital. Repeatedly, being under enemy fire, as part of the surgical brigade of the field airmobile medical detachment, Sergeant Irina Yushkova took part in surgical operations of seriously wounded servicemen as an assistant.



Senior Lieutenant VsevolodYaroslavtsev

Senior Lieutenant VsevolodYaroslavtsev was a platoon commander of the 126 separate Coastal Defense Brigade of the Black Sea Fleet 22nd Army Corps.

He was born in Sevastopol on September 24, 1982, studied at school №336πraduated from Sevastopol State Technical University with a degree in Ships and Ocean Engineering. And he also loved to draw. According to his

second education, VsevolodYaroslavtsev was a teacher of fine arts. From 2007 to 2010 he worked as a restorer in the Sevastopol Art Restoration Workshop. In 2012, he led a drawing circle in the Balaklava House of Children's and Youth Creativity.

He entered military service on February 13, 2014. At first he was a clerk in a military unit, then a draftsman of the headquarters bureau, commander of the security department of the commandant's platoon. In 2015, he graduated from the Lieutenant Courses at the Mikhailovsky Military Artillery Academy in St. Petersburg and chose a military career. Since July 2015, he held the positions of commander in various units of the Black Sea Fleet.

Since September 2021 and at the time of the beginning of the special operation in Ukraine, he was a senior officer of the mortar platoon battery of the motorized rifle battalion of the 126th Separate Coastal Defense Brigade of the 22nd Army Corps of the Southern Military District.

He died on March 4, 2022 in Ukraine while performing combat missions of a Special military operation. Posthumously awarded the Order of Courage.



On March 31, 2022, three sailors from the large landing ship Novocherkassk of the 197 brigade of landing ships of the Crimean Naval Base of the Black Sea Fleet, who died during a Special military operation near Mariupol, were carried out on their last journey in Sevastopol:

Senior Sailor Herman Gutko

He was born in Sevastopol.

Sailor, Radiometrist of the Radio Engineering Team of the Combat Communications Unit Dmitry Kotov

He was born in the village of Azovskoye, Dzhankoy district. He studied radio engineering at Sevastopol State University. Dima did not finish his studies at the university, left the second year for a contract. He was very intelligent, inquisitive, engaged in scientific research.

Sailor EgorTolmachev

He was born in Makeyevka, Donetsk region. Egor graduated from the Maritime College (Sevastopol State University).

These threeheroes were killed while performing combat missions to support the grouping of Russian forces conducting a special military operation in the Mariupol direction. TheyareburiedinSevastopol.

Conclusion. Here is a far incomplete list of Heroes for whom their Feat is an ordinary job, just a military duty, but every moment our brave warriors prove their great love for the Fatherland and devotion to it. Their high consciousness of their patriotic duty, unparalleled courage, heroism, selflessness is another vivid evidence of the indomitable will of Russian patriots for the freedom and independence of their Fatherland. Russian soldiers always act as liberators, not conquerors. This is the origin of their heroism. Even today, Russian soldiers prove their love for the Fatherland and loyalty to military duty hourly on the battlefields. The anthology of the exploits of the participants of the Special military operation will be replenished because every Russian soldier every day writes his page in the biography of the glorious Armed Forces of Russia.

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UDC 902/904

SPIRITUAL AND MORAL ORIGINS OF THE GENERATIONS' HISTORICAL CONTINUITY

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Аннотация. Преданность военной присяге, любовь к Родине как свидетельство преемственности боевым традициям Российской армии и флота являются важнейшими ориентирами для наших воинов, которые,
как и их прадеды в суровые годы Великой Отечественной, ценой своей жизни отстаивают интересы России и защищают её от новой нацистской угрозы. Цель данной статьи – анализ проблемы духовнонравственных истоков исторической преемственности поколений на примере подвигов Зиновия Григорьевича Колобанова, Героя Великой Отечественной войны, и Антона Игоревича Старостина, Героя Специальной военной операции.

Ключевые слова: духовно-нравственные истоки, историческая преемственность, связь поколений, Зиновий Григорьевич Колобанов, Антон Игоревич Старостин.

Annotation. Devotion to the military oath, love for the Motherland as evidence of continuity to the military traditions of the Russian Army and Navy are the most important guidelines for our soldiers, who, like their greatgrandfathers in the harsh years of the Great Patriotic War, defend the interests of Russia at the cost of their lives and protect it from the new Nazi threat. The purpose of this article is to analyze the problem of the spiritual and moral origins of the generations' historical continuity on the example of the exploits of Zinovy Grigoryevich Kolobanov, the Hero of the Great Patriotic War, and Anton Igorevich Starostin, the Hero of the Special Military Operation.

Keywords: spiritual and moral origins, historical continuity, connection of generations, Zinovy Grigorievich Kolobanov, Anton Igorevich Starostin.

Introduction. The victory of the Soviet people over German fascism during the Great Patriotic War is the clearest example of spiritual power, unparalleled heroism and dedication of people of different ages, nationalities, and faiths.

Now, when a new threat to Russia has appeared – Ukrainian neo-Nazism which has received approval and military support from the collective West – thousands of our compatriots are fighting this evil with weapons in their hands to protect Russia from impending disaster. They show courage and heroism on the battlefields, liberating cities and towns from Ukrainian nationalists and foreign mercenaries. Devotion to the military oath, love for the Motherland as evidence of continuity to the military traditions of the Russian Army and Navy are the most important spiritual and moral guidelines for our soldiers who, like their great-grandfathers during the harsh years of the Great Patriotic War, defend the interests of Russia at the cost of their lives and protect it from the new Nazi threat.

Our President emphasized the connection of generations, the special continuity characteristic only of Russia, in his speech on the Red Square on May 9, 2022, putting participants in various battles for the freedom and independence of this country, including the fighters of the Special Military Operation in Donbass, in one row: "With feelings of genuine patriotism, the

militia of Minin and Pozharsky rose up for the Motherland, went on the attack on the Borodino field, fought with the enemy near Moscow and Leningrad, Kiev and Minsk, Stalingrad and Kursk, Sevastopol and Kharkov. And now, these days, you are fighting for our people in Donbass. For the security of our Motherland – Russia" [7].

The younger generation of soldiers, descendants of their glorious greatgrandfathers, with dignity fulfills their military duty to protect the Fatherland, their lands, their people, because the question of the very existence of Russia is at stake. As in the years of the Great Patriotic War, Ukraine has to be liberated at a very high price. But we were not the first to start this war, we were forced to join it.

The purpose of this article is to analyze the problem of the spiritual and moral origins of the generations' historical continuity – Heroes of the Great Patriotic War and Heroes of a Special military operation, who are the successors of the best traditions of combat brotherhood, honor, dignity and courage of their great-grandfathers.

The methodological basis is represented by the works of such authors as N.S. Semenov [5], O. Skvortsov [6], L. Khayremdinov [8], as well as materials of 'round tables' [4; 2], Internet resources [1; 3; 7] dedicated to the problem of the spiritual and moral origins of the generations historical continuity of native land defenders. So, in the center of N.S. Semenov's documentary story is an unthinkable story about the heroic fighting of tankers, gunners and motorized infantry. The author uses concrete examples to show the resilience and courage of Soviet soldiers. Our fighters and commanders have shown these qualities since the first days of the war.

Another researcher of the events of the Great Patriotic War, O. Skvortsov, in his work *Kolobanov's 'Unnoticed' Victory, or 'White Spots' in German Generals' Memoirs* puts forward convincing calculations confirming that, according to the results of the battle with Zinovy Grigoryevich Kolobanov's tank company in August 1941, the Germans should have counted the loss of about 43 tanks, not 22, as indicated in the documents of the German command [6]. In L. Khayremdinov's publication *Descendants of the Fearless Warriors. Russian Servicemen Demonstrate Unparalleled Courage during a Special Military Operation in Ukraine* it is told about the Russian serviceman, senior lieutenant Anton Igorevich Starostin, commander of the tank company of the 126th separate brigade of the Black Sea Fleet coastal defense, who, in fact, repeated Z.G. Kolobanov's feat [8].

Research methods: study, analysis of scientific literature, as well as publications in periodicals dedicated to the problem of the spiritual and moral origins of the generations historical continuity; comparison and generalization of the identified data.

Results and Discussion. Every day we hear about the exploits of our fighters from the fields of a Special military operation. Every day Russia learns new names of heroes. Among them is the commander of the tank company, Senior Lieutenant Anton Starostin. He is only 27 years old, originally from Kaliningrad. In 2016, after military service, he entered the Kazan Higher Tank Command School, from which he graduated in 2020. He served as a tank platoon commander in the 126-th separate Gorlovka twice Red Banner Order of Suvorov Coastal Defense Brigade of the 22nd Army Corps of the Black Sea Fleet coastal Troops (village Perevalnoye, Republic of the Crimea). By the beginning of 2022, Anton Starostin had established himself as a promising officer and was appointed as a tank company commander.

On February 24, 2022, when the Russian Federation launched a Special military operation against the Nazi regime of Ukraine to protect the Russian population of Donbass from genocide, a huge responsibility was assigned to the troops stationed in the Crimea.

On February 25, 2022, Anton Starostin's brigade was tasked with defending the bridge over the North Crimean Canal which was attacked by the enemy. Thanks to Anton's skillful command and coordination of actions, 2 enemy tanks and 8 armored vehicles were destroyed. During the battle, a Javelin hit Senior Lieutenant Starostin's tank from which he received a concussion and injuries, and the tank caught fire. Rolling the car to a safe place, the crew extinguished the fire. Anton Igorevich received a concussion, but did not come out of the fight. Having assessed the condition of the tank and crew, Anton Starostin continued the fight. The whole team was wounded, Starostin himself received severe shrapnel wounds to his back, hip and arm. But the crew continued to fight. Thanks to the bravery and dedication of the crew and their commander, the enemy attack was successfully repulsed.

On March 4, 2022, by Decree of the Russian President Vladimir Putin, he was awarded the title of Hero of the Russian Federation for "heroism, courage, bravery and dedication shown in the performance of military duty".

After treatment, Anton Igorevich Starostin returned to the ranks. Currently, he continues to serve in his 126-th separate Coastal defense Brigade, which was recently awarded the honorary title of Guards for their heroism in the battles against the Ukrainian fascists. The hero of Russia is again leading his tanks into battle, liberating the native Russian lands from Nazi dishonor.

A similar feat was accomplished during the Great Patriotic War. On August 20, 1941, a tank under the command of Senior Lieutenant Zinovy Grigoryevich Kolobanov ambushed a German tank column near Leningrad with the support of a combat guard. Zinovy Kolobanov showed composure and courage – his tank was able to knock out 22 enemy tanks from an ambush, and his compound, consisting of five KV-1 tanks, knocked out 43 German tanks that day.

Here is what N.S. Semenov writes about this feat of Kolobanov in his documentary story *Yushut Calls*, based on archival data from the Ministry of Defense: "The tank company of Senior Lieutenant Zinovy Grigoryevich Kolobanov destroyed forty-three German tanks. Of these, the crews accounted for: Kolobanov – twenty-two, Sergeev – eight, Evdokimenko – five, Lastochkin and Degtyar – four tanks each. In addition, battalion commander Spiller personally burned two tanks. On the same day, the company destroyed: one passenger car, an artillery battery, up to two infantry companies and captured one enemy motorcyclist (Archive of the Ministry of Defense, f. 1355, op. 342639, d. 1, 1. 72.)" [5].

Even after a shell hit Zinovy Kolobanov's tank and the tank turret jammed, and the crew was concussed and injured, the selfless fighters continued the fight because the tank could still shoot. For his accomplished feat, Zinovy Kolobanov was awarded the Order of the Battle Red Banner.

Conclusion. It should be noted that the Russian people have always been distinguished by their patriotism, courage, inflexibility of character and courage. We are people who truly love and appreciate their homeland. The exploits of Zinovy Kolobanov and Anton Starostin show that at all times the Russian man is ready to stand up for his Homeland. Even with the obvious advantage of the enemy's forces, we do not give up because not only our lives are at stake, but also the lives of our comrades, our people, and the fate of the whole country.

We equally bow to the exploits of our great-grandfathers and the exploits of our contemporaries. The battle banner of the great-grandfathers, winners of German fascism, today is firmly held by their worthy descendants, soldiers of a Special military operation, who, just like their ancestors, carry out a historical mission to fight Ukrainian Nazism.

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COMPARATIVE ANALYSIS OF WINEMAKING UNDER THE RUSSIAN EMPIRE AND AFTER ITS BREAKDOWN

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Аннотация. Целью статьи является характеристикапериодов развития виноделия, преимуществ и недостатков определенных промежутков времени. Проведенное исследование становления виноделия как отрасли промышленности в Российский империи и в СССР позволяет проследить как возрождение новых технологий, так и упадок целой отрасли в целом.

Ключевые слова: история, виноделие, технология, Петр I, Павел I, Голицын, винопродукция.

Annotation. The purpose of the article is to characterize the periods of development of winemaking, the advantages and disadvantages of certain periods of time. The study of the formation of winemaking as an industry in the Russian Empire and the USSR allows us to trace both the revival of new technologies and the decline of the entire industry as a whole.

Key words: history, winemaking, technology, Peter the First, Paul the First, Golitsyn, wine production.

Relevance and problem statement. The craft of winemaking has inspired hundreds of thousands of people to leave city life for the country. "Winemaking is an arduous process of observations, sanitization, and practices all for the purpose of shepherding billions of microbes through the bewildering process of fermentation" [1].

Today in Crimea, the total area of vine plantations is 20.4 thousand hectares (ha), of which 16.8 thousand ha are in fruiting. This industry is one of the leading ones. In Sevastopol, the capacity of farms is planned to increase by about 10 times in the next 4 years. Now new seedlings are grown by the Kachinsky + enterprise. The capacity of the grape farm is up to 1 million stalks, which equals to production of 300-400 thousand grape seedlings per year. In 2026, the enterprise plans to increase the capacity of the farms to 6 million grafts per year, which will amount to 3 million grape seedlings.

One should say about continuity of winemaking. It did not arise from nothing, until 2023 there was winemaking, and in some moments it was more developed than now, so this article is relevant.

There were rises in the development of winemaking, but also the complete decline of this industry, which is now being revived.

The **purpose** of the article is to consider the periods of development of winemaking and understand the mistakes and advantages of different times [9]. We try to compare winemaking as an industry in the Russian Empire and in the USSR and understand the difference between technologies.

Methodological base of the study is historical data about wine production in Russian Empire and the Soviet Union as well as different scientifics works connected with given issues.

L.M. Lyalin [6], Q.-A. Zhang, H. Zheng, J. Lin, G. Nie, X. Fan, J.F. García-Martín [13], Y. Alegre, I. Arias-Pérez, Pu.Hernández-Orte, V.Ferreira [8], S. Liu, Y. Lou, Y. Li, Y. Zhao, O.Laaksonen, P. Li, J. Zhang, M. Battino, B. Yang, Q. Gu [10] dealt with various problems of winemaking development.

The main part of the study. Crimea is associated with winemaking. Many tourists travel to the peninsula, not only for the sea, but also for new gastronomic experiences. Crimea was also one of the oldest centers of winemaking. Under the Russian Empire, the rise of winemaking occurred during some stages. Peter the Great invited foreign experts and planted vineyards on the Don in 1706, since these lands were more suitable for viticulture than Astrakhan. Pavel the First estublished institutions for training specialists in the field of winemaking. It is impossible not to say about Golitsyn, who settled in the Crimea and experimented a lot.

During the period of the Russian Empire, up to 2 million liters of wine were produced annually, under Peter the Great up to 20 thousand barrels per year. Having considered the stages of the formation of winemaking, we will find out what influenced the development of this industry.

One should examine winemaking in the Russian Empire from Peter the Great (June 9, 1672 - February 8, 1725) to Lev Golitsyn (August 24, 1845 - December 26, 1915) in more detail, which turns out to be 243 years.

Peter the Great, the man who "cut a window to Europe", the great reformer, also affected winemaking and viticulture. In 1706, the emperor issued a decree on the development of vineyards on the Don, inviting foreign experts. In 1709, the Great Emperor gave a speech to the Don Cossacks, urging them to make wine. One of the foreign specialists, Posyet, was first sent to Azov, but for the reasons stated earlier, was transferred to Astrakhan. The Frenchman immediately realized that the potential of the region is not great, because the grapes do not gain acidity too hot, and because of the claysandy soils, it was necessary to irrigate the land.

. There was another wine-growing region developed by Peter the Great, which still remains. This is Terek in the Kizlyar region.

Further, one of the stages in the development of the wine industry was taken up by **Pavel the First**. Reigned November 17 (6), 1796 - March 24 (11), 1801, during the reign for this branch of production, heequipped an expedition to Astrakhan in order to explore the possibility of expanding the possibilities of winemaking, experts came to the conclusion that poor infrastructure, lacked packaging and other important items for making wine.

The government, concerned about the future fate of domestic winemaking, in 1798 organized the Expedition of the State Economy, which at the end of it presented a report on measures to spread winemaking in Russia [5]. In 1802, the French winemaker General Rouvier proposed to the Russian government to implement this plan to populate the Tekie valley in the Crimea with French winegrowers who could cultivate vineyards, as well as olive trees and fisheries. Soon these ideas began to be implemented. In 1804, in the Sudak valley in the tract Achiklar, the first Crimean school of winemaking was opened [4].

To understand how great a contribution Golitsyn made to winemaking and viticulture in Russia, it should be noted that in the 80 years. Of 19th century total wine production was 11,000 dal (1 dal = 10 l). Russia imported most of the wines. This indicates that Russia could in no way be classified as a country with developed industrial viticulture and winemaking [5]. But thanks to Golitsyn, Russia made huge progress in these industries in the 19th and 20th centuries [2, 3].

This "Golitsyn fairy scene" began with the purchase of the New World, on which he immediately planted vineyards. In the surrounding rocks, Karaul-Oba and Koba-Kaya ordered to cut down cellars 3.5 km long. The tunnels intended for storing wine were located at different heights, due to which a stable temperature of +8 to +12 degrees was maintained in them all year round [2, 3].

By 1912, the area of the Golitsyn estate in the "Noviy Svet" exceeded 200 acres. Having planted about 600 varieties, literally several pieces of each variety, in the surrounding areas. In 1882, the bottling of the first sparkling wine under the names "Paradise" and "Noviy Svet". During the coronation of Nicholas II, Golitsyn made sure that his wine was on the festive table, although it was customary to drink French wines. It was another step towards the rise of winemaking in Russia. In 1900, in Paris, Crimean wine received the Grand Prix, having won against the leading French wineries in a blind tasting [1]. In 1891, in the Massandra natural landmark, the Main Cellar of the Specific Department was laid for aging table, strong and dessert wines [2, 3].

The first circulation of Russian champagne "Abrau-Durso" in the amount of 13 thousand bottles was released in 1896, after which, at the All-Russian Industrial and Art Exhibition in Nizhny Novgorod, the wineries of the Main Department of Destinies were awarded the highest award - the right to depict the state emblem.

One should make an analysis of winemaking from the **breakdown of the Russian Empire** (1917-1921) to one of the USSR (December 1991)

The first decree of the Council of People's Commissars of the RSFSR of December 19, 1919 "On the prohibition on the territory of the RSFSR of the manufacture and sale of alcohol, strong alcoholic beverages and non-alcoholic beverages" did not prohibit the consumption and production of wine, but was aimed at preserving bread, against smoking and selling alcohol for "drinking consumption".

While taking into account that the viticulture and wine-making economy of Russia fell into decay during the Civil War, on August 9, 1921, a resolution of the Council of People's Commissars of the USSR was adopted, which marked the beginning of the restoration and development of viticulture and winemaking in the country. By 1940, the area of vineyards in Russia had increased to 42,000 ha. However, during the Great Patriotic War, a significant number of plantations perished, many wineries were destroyed. In the postwar years, the radical reconstruction of vineyards and the technical reequipment of the industry were carried out at a rapid pace.

Viticulture and winemaking received especially rapid development after 1953. The areas of vine plantations increased by 134 thousand hectares. Wine production has become one of the main sources of income for many farms [6].

In terms of wine production, the Soviet Union ranked fourth after Italy, France and Spain, accounting for 10% of world production. The elite dessert muscats of the Crimea and semi-sweet wines of Georgia, table wines of Moldova and Ukraine, Soviet champagne Abrau-Durso, Novy Svet from the Artemovsky sparkling wine factory, cognacs of Russia, Armenia and Georgia were especially highly valued[11].

However, due to wish to receive productivity, the most valuable grape varieties were destroyed, and at the same time plantations of low-value, but high-yielding varieties grew. As a result, the sugar content of grapes decreased, and the quality of domestically produced wine products fell catastrophically.

The production of low-quality fruit and berry drinks spread throughout the country. Despite this, viticulture and winemaking in the USSR was an important and highly developed branch of the agro-industrial complex, it was considered one of the most profitable branches of agriculture, which brought significant income to the country's budget [6].

Until 1985, the USSR experienced a steady increase in the area and production of grapes. Vineyards occupied in 1984 (the year of the industry's peak) 1.2 million hectares, and yields amounted to 8.1 million tons, which put the country in the top ten world producers of grapes[12].

First, the production of wine materials fell almost 2 times, then more than 300 thousand hectares of vineyards were uprooted [7].

In accordance with the Decree of the Presidium of the Supreme Soviet of the USSR "On measures to strengthen the fight against drunkenness and alcoholism" (May 16, 1985), the area of vineyards and the production of berries decreased. The total production of grapes in the USSR in 1990 amounted to 5.7 million tons (against 8.1 in 1984). Wine production dropped sharply (Fig. 1).

For 1985-1994 planting area decreased by 75 thousand ha and amounted to 89.5 thousand ha at the beginning of 1996, and in 2002 - 70.4 thousand ha (Fig. 2).



Figure 1 – Decrease in vineyard area (in ha)

The average annual production of grapes has decreased from 685.8 thousand tons in 1986-1990. up to 441.7 thousand tons in 1991-1994 years.









Figure 3 – Average annual production of grapes (ton, berries)

Conclusion.Due to the lack of own raw materials and the curtailment of the volume of purchases of wine materials from the countries of the former Union, the existing wineries are used by 20-25%, as a result, the output of wine products in 1994 decreased (table 1).

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Taking into account the development of winemaking in different periods, it is clear that it differs in some aspects, for example, the consumer in the Russian Empire liked imported wines or vodka more, in the USSR the consumer was already directed to buy domestic wine. One should make a conclusion that more wine was produced in the USSR due to better technologies and more government investment in this industrythat has approached the development of wine production with its own methods and capabilities, analyzing a history of the development of winemaking in different periods.

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THE ROLE OF THE PARTISAN MOVEMENT DURING THE GREAT PATRIOTIC WAR

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Аннотация. Роль партизанского движения в коренном переломе в ходе Великой Отечественной войны несомненна. Партизаны в тылу вражеских войск положили начало массовому изгнанию немецкофашистских захватчиков с оккупированной территории нашей страны, стратегическая наступательная инициатива перешла в руки Красной Армии. В статье на основании исторических фактов, архивных документов о деятельности партизан на территории Брянской области и истории семьиавтора обоснована роль партизанского движенияв ходе Великой Отечественной войны.

Ключевые слова: Великая Отечественная война, партизанское движение, территория Брянской области.

Annotation. The role of the partisan movement in the radical turning point during the Great Patriotic War is undeniable. The partisans in the rear of the enemy troops initiated the mass expulsion of the Nazi invaders from the occupied territory of this country, the strategic offensive initiative passed into the hands of the Red Army. The article substantiates the role of the partisan movement during the Great Patriotic War on the basis of historical facts, archival documents about the activities of partisans in the Bryansk region and the history of author's family.

Keywords: Great Patriotic War, partisan movement, the territory of the Bryansk region.

Introduction

Recently, some publicists and historians, not only abroad, but, unfortunately, also in Russia, have been trying to falsify the history of the

Great Patriotic War and belittle the role and significance of theSoviet people's Great Victory over German fascism.

The Great Patriotic War was not just a war for our people. German fascism aspired not only to military success. It set as its ultimate goal the complete liquidation of the Soviet Union, the extermination of the entire population, its complete destruction as a national community, the seizure of our ancestral lands with their subsequent colonization.

The immortal feat of the Soviet people, who saved not only this country and all mankind from the threat of fascist enslavement, serves as an inspiring patriotic example for all of us. The history of the tragedy experienced by the people and the Victory achieved is a source not only of pride and glory of our people, but also of pain and bitterness of untimely losses, losses of loved ones and dear people. This is the price that had to be paid for the Victory.

The purpose of this article is to analyze the role of the partisan movement during the Great Patriotic War on the basis of historical facts, archival documents about the activities of partisans in the Bryansk region and the history of the author's family.

MaterialsandMethods

The methodological basis of the study is represented by the works of such authors as: V.A. Tomsinov [7], O.A. Rzheshevsky [6], N.F. Goncharov [5], E.N. Abovyan [1], V. Afonin [2], E. N. Shantseva, V.V. Dzyuban, Yu.T. Trifankov [3].

Thus, in the handbook edited by O. A. Rzheshevsky*Who was who in the Great Patriotic War 1941-1945. People.Events.Facts* [6] contains historical data onpartisans' activities in the occupied territory. In N.F. Goncharov's work [5]on a variety of the facts and figures the importance of partisan movement in fundamental change during the Great Patriotic War is shown.V. Afonin [2] and E.N. Abovyan [1] analyze the formation of the partisan movement in the Bryansk region. Intheir monograph, E.N. Shantseva, V.V. Dzyuban, Yu.T.Trifankov [3]consider the genesis of the partisan movement and collaboration in the Bryansk region during the occupation in 1941 – 1943.

All researchers who studied the problem of the partisan movement during the Great Patriotic War agree that the contribution of the partisans to the overall victory over the enemy was extremely significant and priceless.

Research methods: analysis and synthesis of scientific sources, historical facts dedicated to the problem of the partisan movement; comparison and generalization of the data obtained.

ResultsandDiscussion

The centuries-old history of Russia has never seen such a broad scale of the partisan movement as during the Great Patriotic War against the Nazi invaders. Many residents of the occupied territories joined the partisans in order to fight the enemy. Their bravery and coordinated actions against the enemy made it possible to significantly weaken its forces, which influenced the course of the war and brought victory to the Soviet Union. People of different ages and different physical abilities joined the partisans. But all of them were united by love for the Motherland, and all of them equally showed a high consciousness of their patriotic duty, courage, heroism, selflessness.

The formation of partisan detachments was caused by the brutal Nazi order, as well as the forcible removal of civilians from the territory occupied by the enemy into slavery in Germany. In the first months of the war, there were several partisan detachments. But by the beginning of the autumn of 1941, the movement of partisan detachments had significantly intensified and began to wear a more organized order. The leaders of the partisan movement during the Great Patriotic War often were ordinary peasants who had no military training.As E.N. Abovyan notes, several dozen partisan detachments were organized on the territory of the Bryansk region [1].

One of the leaders of such a partisan detachment in 1942 was my greatgreat-grandfather AvrinVasilyAndreevich. By the decision of the city party committee, he was left behind enemy lines to organize a partisan movement in the Brasovsky district of the Bryansk region.

VasilyAndreevichAvrin'spartisan detachment was engaged in undermining railway tracks, bridges and echelons, depriving the enemy of the possibility oftroops rapid transfer, ammunition and provisions over long distances. In addition, the partisans captured Germans and handed them over to Soviet intelligence so that they would find out the enemy's plans.

In general, based on documentary materials, we can note that gradually the partisan movement gained combat experience, developed its own fighting techniques. The partisans carried out sudden attacks on enemy garrisons in cities and towns, attacked columns of enemy troops on the march. They set up ambushes on the roads, destroying the occupiers' manpower and equipment. They cut highways, blew up enemy trains on railway tracks, successfully waged a "rail war", paralyzed the work of the enemy rear, disrupted all economic and political activities of the occupation authorities. Many partisan detachments began to carry out bold long raids on the enemy's rear.

At least the following data can testify to the scale of partisans' actions. According to incomplete data, the partisans organized more than 21 thousand train wrecks with enemy troops and military equipment, disabled 1,618 steam locomotives, 170.8 thousand wagons, blew up and burned 12 thousand railway and highway bridges, destroyed and captured more than 1.6 million enemy soldiers, officers and their accomplices, delivered a lot of valuable intelligence data to the Red Army command [6].

When the partisans began to inflict significant damage to the enemy, the fascists organized a punitive operation. The partisans themselves could have

left the encirclement, but their wives, children, and elderly parents lived in the villages of the district. They had to be notified and saved from impending disaster.

However, it was not possible to leave. The detachment was captured along with their families. A camp was organized in the stables on the territory of the village of Lokot, Brasovsky district. And people were brought here. The families were divided. The men were locked in a separate stable; their wives, children and the elderly were locked in another one. Close people could see each other through the wire fence, but had no opportunity to communicate.

The next morning, all the partisans were taken out of the stables and machine-gunned down in front of their families. In the last minutes of his life, my great-great-grandfather tore off his hat and threw it over a wire fence shouting: "Goodbye, remember us!"

The whole day the hat lay by the wire, and at night the eldest son of my great-great-grandfather, who was 11 years old at the time, crawled under the wire and took it away. It is still kept in our family. This is all that remains of my great-great-grandfather, except for the grave and our memory of him -a strong man with a pure and open soul, a cheerful and talented harmonica player, a beloved and caring father and husband.

The fact that VasilyAndreevichAvrin's squad was ambushed will remain on the conscience of traitors who supported the fascist regime.

The matter is that in the occupied territory of the Bryansk region, in the Brasovsky district, the Lokot Republic was formed, whose leaders were traitors who sided with the Nazi regime. They assisted this regime and during the occupation more than 10 thousand civilians suspected of assisting the partisans were shot on the territory of the Bryansk region[3].



The partisans took revenge on the fascists for the deaths of their comrades and their families. Already on December 15, 1941, at the Nerussa station (in the Suzemsky district), the commanders and commissars of the partisan detachments located in the southern part of the Bryansk forests, as well as the secretaries of several underground party district committees decided to coordinate their actions and created a joint headquarters [2]. And on January 7, 1942, partisan detachments – Trubchevsky named after Stalin,

Suzemsky "For the Power of the Soviets", Brasovsky "For the Motherland" and Saburov's detachment – together defeated the German garrison in the village of Lokot of the Brasovsky district. In the battle, the German protege of the chief burgomaster of the Lokot district, Voskoboynikov (the pseudonym of German intelligence "Earth"), was destroyed [1].



During the war, the interaction of the partisans with the Red Army was strengthened. Usually, partisans timed attacks on enemy communications to coincide with the Soviet troops' offensive operations. Partisan formations and detachments helped Soviet soldiers to overcome water boundaries. So, during the Battle for the Dnieper, the partisans prepared and handed over 25 crossings to the Red Army [4]. With the Red Army's entry into the bases of large partisan formations, the interaction became even stronger and played an even greater role in defeating the enemy.

Conclusion

In the battles with the Nazi invaders, the partisans accumulated considerable combat experience, forged cadres of trained and knowledgeable commanders, fearless fighters and turned into a formidable force for the enemy. Together with theRed Army's soldiers, they participated in large-scale and complex operations which were of strategic importance during the war. The partisans' combat experience was taken into account by the Soviet High Command when planning and conducting offensive operations. The partisan movement is evidence of the nationwide nature of the war against the invaders, of the Soviet patriots' indomitable will for the freedom and independence of their homeland.

Our duty is to preserve forever the bright memory of the heroic generation of our great-grandfathers and grand-grandmothers, of those who won a historic victory over the Nazi invaders during the Great Patriotic War, defended the independence of our Motherland in fierce battles.

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SECTION 4: MARINETECHNOLOGIES



UDC 656.61

RESEARCH OF THE PROSPECTS FOR THE USE OF SMART TECHNOLOGIES IN NAVIGATION

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Аннотация. В данной публикации рассматриваются перспективы развития информационных технологий, дополненной реальности, информационной безопасности автономного управления И в судоходстве, а также проблемы, связанные с внедрением этих технологий на судах. В научной работе исследуются основная проблема и преимущества каждой технологии, их влияние на морскую профессию в целом. на уровень повышения безопасности мореплавания, затем подводятся итоги исследования и делается вывод.

Ключевые слова: Информационные технологии в судоходстве; способы улучшения кибербезопасности; дополненная реальность; блокчейн; удаленный мониторинг; использование трехмерной карты в судовождении.

Annotation. This publication discusses the prospects for the development of information technologies, augmented reality, autonomous control and information security in shipping, as well as the problems associated with the introduction of these technologies on ships. The scientific work explores the main problem and advantages of each technology, their impact on the maritime profession as a whole, on the level of improving the safety of navigation, then sums up the result of the research and draws a conclusion.

Keywords: Information technologies in shipping; ways to improve cybersecurity; augmented reality; blockchain; remote monitoring; use of a three-dimensional chart in navigation.

Introduction.

Modern shipping does not stand still and is constantly evolving, the era of information technology begins. At the moment, there are many new systems and equipment based on information technology. The question is raised about the possibility of replacing devices of the previous generation. It remains to be seen what are the positive and negative aspects of these technologies, what problems may hinder their implementation, and whether they are needed now.

Tasks:

- find out what new technologies are already used on ships or will be used in the foreseeable future;

- understand how these technologies are developing, how they work and whether they are in demand in shipping;

- to determine the positive and negative aspects of the introduction of such technologies in navigation.

Using a 3D chart in navigation.

Porate [6, p.43] conducted an experiment comparing 4 types of maps:

- traditional paper sea chart (to the north);

- electronic chart system (to the north);

- electronic cartographic system (head-up);
- 3D egocentric map shown in Figure 1.



Figure 1 – Three-dimensional map in navigation.

The test results show that the 3D map allows for faster decision making and is perceived by the user as a more convenient option. Witt [5, p. 21] proposed using such maps on tablets as an aid to navigation, in his opinion, such a solution can reduce cognitive load. The advantage is that the navigator can more accurately understand which objects on the map correspond to objects in the real world with the help of a robot, which will help to avoid many accidents. Implementation of augmented reality technology in order to provide high-quality visualization.

Teleoperation can be used for remote control of machines, robots, and ships. So far, this technology has been actively used only in driving cars around the city. Williams et al. [7, p.47] talk about how augmented reality (AR) and virtual reality (VR) can enhance visualization and thus the overall connection between a robot and a person, which will also help to more effectively control a ship remotely.

Augmented reality [1, p. 24] is a system that consists of a camera, sensors and a cartographic image. If we take the design of most navigation bridges as an example, they do not allow for full visibility due to shadow sectors. But with the introduction of augmented reality systems on the bridge, such problems can be avoided, which in itself increases the safety of ship control. MOL plans to install a navigation system using augmented reality on its VLCC tankers. According to the company, the system was developed by MOL Techno-Trade, Ltd. in cooperation with Furuno Electric Co., Ltd. The system shown in Figure 2 can display nearby ships, marine environment, shoals and other features.



Figure 2 – Navigation bridge simulator with the function augmented reality.

Autonomous ships as a full replacement for existing ships.

At the moment, controlled ships are not something unusual and even real. Autonomous ships [3, p.36] are best viewed as the next branch of the development of already existing ship subsystems. All together this gives an autonomous vessel. For clarity, one should divide the smart vessel into 4 main elements in the following diagram:



Figure 3 – The structure of an autonomous vessel.

Navigation: The ship has a system that receives data from various sensors on the ship. The data from these sensors is combined by a software block and creates a real image.

Guidance: The guidance subsystem uses the real image to detect obstacles and the status of other ships in real time in order to navigate from destination to destination.

Technical equipment: to support the software decision-making system, additional equipment is installed on the ship, which is located on the bridge in the place where the ship's control was previously located, providing the same view for obtaining information.

Control: The motion controller is what guides the ship on the right path. The control system processes the data, converting it into commands for the equipment that controls the ship.

An already existing prototype of an autonomous vessel, shown in Figure 4, works according to a similar scheme.



Figure 4 – The concept of an autonomous vessel Yara Birkeland.

Development of autonomy on ships.

The main advantage of a smart ship is the ability to work autonomously. A whitepaper was published that discussed a possible evolution from modern

ships to fully autonomous ships. This is called levels of autonomy [4, p.4], 6 levels of autonomy are shown in the diagram:



Figure 5 – Levels of autonomy.

Level 0 implies complete human control over the vessel, level 6, on the contrary, shows the complete autonomy and unmanned vessel.

Level 0 - Steering or course setting is done manually.

Level 1 - automatic course and speed control in accordance with the set route. Speed and heading are measured by sensors.

Level 2 - Airborne or shore based decision support: route guidance through a sequence of desired positions. The system can download a new route plan.

Level 3 - General navigation and operation decisions are calculated by the system. Decisions are made by the system based on sensory information from the ship and its surroundings.

Level 4 - Navigation is carried out with a leader who controls and can interfere with management. Almost everything is calculated by the system, which performs the calculations after the approval of the operator.

Level 5 - Controlled autonomy, overall navigation and operation decisions are calculated by the system. The operator is contacted in case of uncertainty in the situation.

Level 6 - Full autonomy, navigation and operational decisions, as well as consequences and risks are calculated by the system. Knowledge of the environment is included in machine intelligence.

Prospects for the introduction of autonomous systems in the marine industry.

Already, many ships are implementing partially autonomous systems of levels 1-3. This indicates the possibility of developing autonomy and moving ships to the next levels, which can reduce the number of jobs in navigation. Most likely, a person will participate in the work, but only on ships with controlled autonomy. Otherwise, navigation is waiting for a working crisis. Of course, you don't have to worry about this yet, because the development, construction, testing and development of smart ships will take more than a dozen years, not to mention the huge costs and investments in the production of such ships. Consider the issue of security. According to some studies, between 75 and 96% of maritime emergencies are due to human error. In 2011-2016, almost 15,000 insured events for liability for emergency marine accidents, which is equivalent to an insurance amount of more than \$ 1.6 billion, occurred due to human errors. Does this make the introduction of autonomous courts necessary? At least inevitable. And yet, the author does not agree that smart ships can fully improve maritime safety. If we take into account rescue vessels, research vessels and fire extinguishing vessels, the situation does not seem so encouraging, it is impossible to imagine the listed services without human participation in their work. In this case, the development of artificial intelligence requires much more time and effort.

In this case, given the above problems, we can say that the introduction of autonomous systems has some prospects in the distant future, creates new security conditions, but also negatively affects the availability of jobs. Therefore, it is not yet possible to say that these systems will become fundamental in navigation.

The use of blockchain to improve information security on ships.

Blockchain [2, p.83] is a ledger technology that securely stores documents, ship data, customs records, contracts, marine insurance policies, and can be managed in multiple places at once through individuals. In addition, blockchain in the maritime industry can be used to track cargo in real time. The technology has yet to be ubiquitous, but Maersk and IBM are already set to form a joint venture to develop a similar industry-wide registry so that companies can move goods across international borders and track them digitally. In the following diagram, you can clearly understand how this registry works:



Figure 6 – Scheme of the blockchain.

The point is that the connection between the blocks is ensured by the fact that each block contains both its hash sum and the hash sum of the previous block. Therefore, to edit information, it is necessary to edit the entire chain of blocks, in addition, copies of these chains are contained in different places on different computers. All this provides effective cyber security for the registry and the data it contains about the vessel.

Conclusion.

In a scientific article, the author examined what technologies are currently used on ships and which ones are still being developed, how they work and how they develop. Despite the clear threat to navigation as a profession in the future due to the automation of equipment and ships, information technology shows itself as a promising direction in shipping, as it increases the security of information, human life and movement of ships at sea, and also speeds up and greatly simplifies all types of work. for the navigator, therefore, they may well replace the current equipment and begin to develop rapidly.

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PROBLEM OF ELECTRICAL INJURES ON SHIPS

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Аннотация. Проблемы соблюдения правил охраны труда и безопасности человеческой жизни на море являются важнейшими при работе на судах. В настоящее время остаётся актуальным вопрос защиты членов экипажа от поражения электрическим током. Несмотря на то, что статистические данные об объёмах электротравматизма в море выглядят незначительными, любое судно является потенциально опасным. Технические меры защиты устарели требуют И совершенствования, а организационные лостаточно не всегла эффективны.

Ключевые слова: безопасность на море, электротравматизм, поражение током, защита от электротравм.

Annotation. The problems of compliance with the rules of labor protection and safety of human life at sea are the most important when working on ships. Currently, the issue of protecting crew members from electric shock remains relevant. Despite the fact that statistics on the volume of electrical injuries at sea look insignificant, any vessel is potentially dangerous. Technical protection measures are outdated and require improvement, and organizational measures are not always effective enough.

Keywords: safety at sea, electrical injuries, electric shock, protection from electrical injuries.

Introduction

With the development of marine technology, the problem of protecting people from electric shock remains one of the most important. According to statistics, electrical safety indicators still remain at a fairly high level.

At the same time as very dangerous vessels, which are operated in large numbers in several domestic fleets, there are also those for whom the problem of preventing accidents due to electric shock has been almost completely solved.

The number of people affected by electric shock over a long period of time looks relatively small, because the number of deaths is calculated not per crew member, but per vessel. Since the number of victims goes from six to ten people a year, the value is considered negligible, and the ship is recognized as safe.

The main part

Within the framework of the general complex of electrical protection, priority is usually given to organizational preventive measures. In this direction of protective actions, the assumption is realized that in order to prevent fatal electrical injuries, people should be affected in such a way that they understand the need to exclude dangerous touches to electrical equipment. This, in turn, requires appropriate professional training of crew members, including electrical and safety training.

It is also necessary to maintain service and household discipline at a high level, increase the personal and collective responsibility of enlisted personnel and managers at all levels, as well as observe the established work and rest regime, allowing crew members to perform their duties without mistakes and blunders.

Practice shows that organizational measures to influence the human factor have very limited possibilities. They certainly prevent many accidents and should be considered as a necessary and important part of the overall electrical protection complex. But at the same time, it is quite obvious that organizational measures are not capable of independently ensuring a high level of safety of marine equipment. Even with their very intensive use, which takes place, for example, when working with the crews of warships or with the teams of electrical departments of industrial enterprises, it is not possible to completely avoid dangerous touches to electrical equipment in them. The consequences of such touches can be very serious and are reflected in the statistics of fatal electrical injuries.

Technical measures, unlike organizational ones, are potentially capable of ensuring the complete safety of a person on a ship. The effect of the technical component of the general complex of electrical protection is aimed at eliminating or compensating for the design flaws of mechanisms that create conditions and prerequisites for fatal electrical injuries, they are prescribed in the GOST standard.

To ensure protection from direct contact, the following technical methods and means are used:

- basic insulation;

- protective shells;
- protective fences (temporary or stationary);

- protective barriers;

- safe location of live parts, placing them out of reach of body parts and limbs;

- voltage limitation, ultra-low voltage applications;

- equalization of potentials;

- warning lights, sound alarms, security locks, security signs, and more.

One of the solutions is to choose the voltage class of the network. The condition for choosing the rated voltage is the optimal combination of low

electrical hazard of ship electrical installations with their high efficiency. Theoretical studies and experimental operation of various samples of marine equipment with different values of nominal voltages allowed us to make a decision on the use of voltages that do not exceed 400 V.

The next solution is to establish a neutral regime for electric power systems. For DC and AC electrical systems installed at offshore facilities, the isolated neutral mode is selected. This means that all elements of the onboard electrical systems are isolated from the hull of the vessel.

It is obvious that radical differences in the results of the use of the same protective complexes, which coincide in their organizational and technical components, can only be explained by the peculiarities of the ship's electrical installations themselves.

It follows from the above that the main direction of work to ensure complete electrical safety of ship equipment should be recognized as the development of technical means of protection. This should be done taking into account the individual characteristics of the onboard electrical systems on each of the vessels.

Monitoring of compliance with electrical safety requirements must be carried out at the following stages:

- ship design;
- manufacturing and installation (including testing and commissioning);
- operation;
- reconstruction.

During operation, it is necessary to assess the risk of dangerous and harmful effects of electric current, electric arc and electromagnetic fields on personnel. Based on the results of the risk assessment, measures should be developed to eliminate or reduce risk, as well as risk management. The requirements for risk assessment and risk management are determined by relevant international standards and national regulatory legal acts.

Unfortunately, the insufficient effectiveness of the existing protection systems against electrical injuries has not yet been overcome, despite all attempts to improve it over several decades. This circumstance directly indicates a systemic crisis in solving the problem of electrical safety of marine equipment. Measures to improve the current protection are insufficient to resolve it. It is necessary to change the approach to solving the security problem itself. The development of a new concept for the prevention of fatal electrical injuries on ships and ships should provide for the identification and elimination of existing systemic deficiencies of the protection used, since they do not significantly improve the electrical safety of marine equipment.

The following describes some of the systemic shortcomings of the current electrical protection complex, which are caused by the statically rare

realization of the event of people dying from the current. Firstly, the systemic disadvantages of the complex include the inability to obtain any quantitative hazard assessments for each object separately on its basis. As a result, this crucial operational characteristic remains uncertain. It is not standardized and is not controlled.

Currently, it is impossible to subdivide marine equipment according to the hazard levels of individual objects, it is impossible to determine the need for additional means of technical protection against electric shocks, and it is also impossible to solve a number of other important tasks for managing individual levels of electrical hazard of ships.

It is known that this flaw is really systemic. It has a very significant impact on the current capabilities of the existing electrical protection complex, and also determines the results of future attempts to increase its effectiveness. Secondly, an important disadvantage of the current complex should be recognized as its inertia in obtaining any quantitative data on the levels of electrical safety of marine equipment, even in cases where obtaining such estimates is fundamentally possible.

In these cases, the accumulation of initial data on fatal electrical injuries should last for several years, which practically excludes even setting the task of studying the influence of many individual factors on the level of electrical safety of the fleet as a whole. As a result, attempts to improve the electrical safety system on ships are being made in the absence of the necessary initial data. Only this can explain the fact that the current electrical protection complex has been preserved for many years almost unchanged, despite its insufficient effectiveness.

Also, the systemic disadvantages of the complex should also include its non-selectivity in application. The organizational and technical measures combined in it are uniform both in content and in use. They are designed for all vessels, regardless of their individual characteristics. Meanwhile, it was shown above that it is the features of on-board electrical systems that determine the effectiveness of protection against electric shocks and the possibility of achieving a high level of safety by current and prospective means. The unpredictability and spontaneity of the results achieved through the use of the current protective complex is another side of its selectivity. So far, we cannot even approximately assess the sufficiency of such protection in relation to certain groups of marine equipment. The composition of the systemic shortcomings of the electrical protection complexes of domestic naval fleets is not limited to those noted above. Their more detailed analysis requires a separate consideration of the features of the application of organizational and technical protective measures.

Conclusion

In conclusion, based on the information provided, some conclusions can be drawn. The current complex of electrical protection measures does not have the necessary efficiency. At the moment, the electrical protection complex has a number of systemic drawbacks. Their elimination, carried out by gradual improvement of individual protective measures, is fundamentally impossible. In this regard, the revision of the measures of the complex should represent a change in the very concept of solving the problem of ensuring the safety of people at marine equipment facilities.

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PREPARING A TANKER FOR LOADING

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Аннотация. Рассмотрена организация танкера к погрузке нефтепродуктов. Охарактеризованы меры предосторожности при мойке танков различными методами. Представлено описание видов мойки для удаления загустевших остатков нефтепродуктов.

Ключевые слова: танкер, погрузка, нефтепродукты, мойка, ржавчина, химико-механизированный способ, механизированная промывка.

Annotation. The organization of a tanker for loading oil products is considered. Precautions for washing tanks by various methods are characterized. A description of the types of washing to remove thickened residues of petroleum products is presented.

Keywords: tanker, loading, oil products, washing, rust, chemicalmechanized method, mechanized washing. **Introduction.**Before a tanker approaches any port, several factors must be considered: testing of ballast and sea valves, emergency stops pumps, pipelines, inert gas systems; preparedness of life-saving fire-fighting, and anti-pollution equipment; ensuring that oil record book is filled; preparation of tanks, including readiness of slop tanks and other points. **The purpose** of the article is to consider the organisation of a tanker for the loading of petroleum products.

Main material. Any organisation of a tanker for the loading consists of preparing the cargo tanks, testing the loading procedure and the cargo securing systems [7].

"Consideration of the rate of loading must also be taken into account given electrostatic hazards when handling static accumulator oils where an electric charge can build up utilizing flow or turbulence" [5].

The cleaning of cargo tanks is particularly labour intensive and can be manual, mechanised or chemical-mechanised. The organisation and execution of the scientific and technical process of tank washing must include any possible mechanisation of complex activities and the elimination of human exposure to hazardous and harmful production factors. The Chief Officer-in-Charge is responsible for the safety of preparation and drawing up the washing service - for work in cargo tanks and the Chief Engineer - for work in fuel tanks [1]

The manual method is time-consuming and expensive. The tank is pumped with cool seawater, then steamed for some hours. When the temperature in the tank has dropped to 30-40°C, venting is started. At the end of venting two washers are oriented into the tank to wash manually from hoses with hot water with a temperature not exceeding 45°C and pressure not exceeding 0.6 MPa (6 kgf/cm2). The washers are required to wear protective clothing, and to use sleeves or insulating respiratory apparatus.

Mechanisation - washing is carried out with seawater of different temperatures or with detergent solutions, which are fed into the tanks by pressurised washing machines.

Mechanised washing is carried out: with seawater or

with an open-circuit washing solution;

with seawater or a closed-circuit detergent solution;

cryogenic washing and crude oil washing with inert agents [5].

The following precautions should be observed when washing tanks by any method to avoid oil going overboard:

- receivers on deck cargo, stripping and washing lines which are not involved in tank washing according to accepted technology should be thoroughly closed;

- bottom and outboard valves in the pump room must be securely closed;

- before starting the wash, the wash lines must be cleaned and the wash water drained into the sump tank;

- deck scuppers kept closed;

-washing liquid on the cargo deck must be removed immediately;

-when water is pumped overboard, the oil content in the water is inspected with the help of express analysis or automatic instruments.

When starting to wash the tank, the tank neck and sight-glass must be closed and the wash throat, through which the washer is lowered, must be opened. When washing machines are in use, care must be taken to prevent washing spray from escaping through the throat onto deck by the use of special brackets or by blocking the gap between the lid and the throat coamings with a mat. The effect of using washer-dryers is achieved by the impact of the jet of washing fluid, small-sized jet, emerging from the nozzle diameter of 8-9 mm at a distance of 5 m washes a strip width of 150-220 mm [4].

Washing takes place with seawater heated to 60°C, in the upper position of the machine at a distance of 2-3 m from the upper deck, the immersion depth of the machine being adjusted with a rubber (anti-static) hose.

A waterjet ejector is used to remove rust and water residues, then proceed to flush the load and stripping pipes with hot water heated to $75-80^{\circ}$ C.

The chemical-mechanised method ensures good quality and shorter cleaning times and eliminates the discharge of oil products into the sea.

The tanks are cleaned using the same agents as the mechanical method, but washing solutions (alkaline, basic solvents and preparations) are used instead of water.

The solution is prepared in one of the tanks or in a special tank on the shore, using water heated to 40-50°C and a special stirrer. To achieve a homogeneous concentration, the solution is bubbling by pumping (tank-pump-tank) [7].

The temperature of the washing solution fed to the washing machines must be at least 75-85°C, at lower temperatures the washing process is considerably worse and a higher concentration of the solution is required, which increases the consumption of the detergent. pumping out the emulsion from the tank during the washing process must always be done to avoid the creation of ground deposits. the closed-circuit tank cleaning concept guarantees the possibility of cleaning tanks with double-sludge, which reduces the work involved by eliminating the preparation and dosage of the solution [6].

Solvent washing in preparation of cargo tanks for change of cargo grade is carried out by pumping method, solvent collected from tanks after washing is delivered ashore [3].

the method of removing oil product fragments is done by specific pumping of the residue with a pumping unit, 'lifting to water', washing out the residue with solvent and then pumping it out again.

In order to remove thickened oil residues a tank wash with crude oil is used which is carried out only at the moment of tanker discharge and the oil used for washing is removed to the shore together with the discharged cargo. Crude oil washing of cargo tanks can be done after the cargo of crude oil and in an inert gas environment. In case of one-stage method - tank washing is carried out after tank unloading with withdrawal of washing oil from other tanks. In two-stage method - washing of the bulkheads is carried out simultaneously with unloading of the washed tank, then after full unloading of the tank the bottom is washed with withdrawal of washing oil from the discharged cargo of other tanks.

Tank washing with crude oil cargo has the following advantages over water washing:

- limiting the amount of manual labour for picking up thickened residues;

- Increasing the ship's cargo capacity by better removal of non-vacuumable cargo fragments during unloading;

- calculation of loss of cargo eliminated by water washing;

- Reducing ship hull rusting from the impact of seawater washing jets on the metal.

Conclusion. After loading completion the tanks will be gauged once again to ascertain the quantity of cargo loaded. The vessel will be cleared for sailing after calculations and comparing with shore figures.

The results of the inspection of the tanks, lines, clinkers and the readiness of the vessel to receive petroleum products shall be recorded in the ship's log.

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UDC62

SHIPBOARD MAINTENANCE IN EXTREME WEATHER CONDITIONS

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Аннотация. В данной статье рассматривается влияние погоды на безопасную эксплуатацию судна, а также приведены случаи кораблекрушений, вызванных экстремальными погодными условиями и неспособностью членов экипажа с ними справиться. Целью данной статьи является поиск правил для командного состава и экипажа судна по действиям при экстремальных погодных условиях, для избежания травм, смертей, потери груза и судна. Данные правила разбиты на три группы для более эффективной эксплуатации судна в экстремальных погодных условиях.

Ключевые слова: погода, море, судно, двигатель, потеря.

Annotation. This article mentions the effect of weather on the safe susceptibility of ships, as well as the detection of occurrences of wrecks, the occurrence of extreme weather conditions and the inability of the crew to cover them. The purpose of this article is to find rules for the officers and crew of the ship to deal with increased injuries, deaths, weight reduction and cargo movement. These rules are divided into three groups for larger operation of ships in extreme conditions.

Keywords: weather, sea, ship, engine, loss.

Incidents in recent years have highlighted the dangers of extreme weather conditions at sea, drawing attention to the need for action to improve the safety of life and property on board ships. Hurricane-force winds and phenomenal waves are of particular danger to sea vessels, regardless of their size. Ships operating at high latitudes, in addition to the more well-known hazards posed by icebergs and sea ice, also face the threat of ice spray. Despite the availability of high-resolution satellite imagery, increasingly sophisticated numerical weather forecasting models, and improved forecasting services, ships continue to get lost at sea in the twenty-first century. The loss of the SS El Faro off the Bahamas with all 33 souls aboard during Hurricane Joaquin in 2015 was especially notable. The subsequent investigation revealed problems with the ship's decision-making processes, in particular the correct use of hurricane forecasts and the importance of timely information in rapidly changing weather. In 2019, the tugboat Bourbon Rhode was lost during Hurricane Lorenzo in the Atlantic Ocean, killing 11 of the 14 crew members. In 2020, Typhoon Maysak claimed the lives of Gulf Livestock 1 in the East China Sea, with only 2 of 43 crew members surviving; about 6,000 head of cattle died.

Extratropical cyclones at sea can be just as dangerous as the strong winds and waves generated by hurricanes. These systems cross mid and high latitudes and often move forward faster and faster than tropical cyclones, resulting in a rapid change in the state of the sea. In the North Pacific and Atlantic Oceans, hurricane-force winds associated with extratropical cyclones occur more frequently than hurricanes. In February 2016, the Anthem of the Seas cruise ship, en route from New York to Port Canaveral, Florida, experienced strong winds due to a growing winter storm. needed repair [1].

In March 2019, the Viking Sky cruise ship lost its engine in rough seas off the rocky coast of Norway. Luckily, the anchors were kept close to shore, which felt like the evacuation of some 460 passengers by helicopter before being towed to port [4].

In December 2020, a series of fatal ship losses occurred in the South China Sea. Near the end of December 2020, the fishing vessel Yong Yu Sing #18 operating in the open waters of the North Pacific was lost approximately 530 nautical miles to the northeast. Midway Island, during a very strong hurricane-force storm. Although the ship survived the storm and was discovered, her crew of 10 appears to have abandoned ship; none were found [5].

Late 2020 saw a marked increase in container losses and damage, especially in the North Pacific. In particular, ONE Apus, en route from Yantian, China to Long Beach, USA, was well south of a major hurricane in late November, but still experienced phenomenal container loss and damage.

Over 1,800 containers were lost overboard and others were damaged, far exceeding any previous documented loss of containers without the loss of the ship itself.

Although many losses at sea can be attributed to high winds and waves, icing on the superstructures and masts of ships operating at high latitudes can lead to their destabilization and capsizing. Ice spray and subsequent icing may have been a significant factor in the sinking of both the Scandi Rose off the coast of Alaska, which killed five people in late December 2019, and the Russian trawler Onega in the Barents Sea, which in December seventeen people died. 2020. Extreme maritime weather continues to contribute to the loss of cargo, ships and crews. However, research has identified a number of causal factors other than the weather. Under the Convention for the Safety of Life at Sea (SOLAS), WMO and IMO have worked together to reduce the vulnerability of the maritime community to hazardous or extreme weather events at sea. Despite this, unacceptable loss of life and property continues to occur at sea. In view of this and recognizing the growing demand for maritime services that provide collision-based forecasts for better decision making, in October 2019, WMO and IMO jointly hosted the first international symposium on "Extreme Maritime Weather: Towards a Safer Life at Sea". and a sustainable blue economy" at IMO Headquarters in London. It was attended by over 200 participants from over 40 countries representing the private and public sectors, including government ministers and ambassadors.

With this regard, in its latest issue of The Navigator, The Nautical Institute provides guideline for mariners about observing and coping with weather at sea. Recommendations provided can be categorized into 3 groups

- 1) general weather rules
- 2) rules in machinery space
- 3) measures relating to safety working practice

General weather rules must be observed by personal of deck department. Officers must familiarize themselves with the current weather, any changes and the best forecast. Every port stay or passage plan should include an element of weather prediction. Always have contingency plans for known and unknown weather patterns. It is important to keep weather recordings both to identify change and patterns and to ensure commercial accountability. It is advisable to monitor the weather by all available means – the barometer, coastal and port reports and weather prediction services. Modern technology provides unprecedented opportunities for predicting weather – but always test these predictions against your observations. If a change in the weather is identified, it is required to alert others. Extra securing may be needed when at sea. Being aware of the weather and acting

accordingly is important for both safety and efficiency. Lives may depend on it [3].

The following guideline may be used by officers in charge of engineering department when operating and maintaining shipboard machinery.

If merchant ship is subjected to cold weather outside water equipment and valves must be opened, e.g. fire valve, cargo valve, ballast valve, as the expansion of water during freezing can destroy and damage them. Level of all the important tanks is to be maintained so that pump inlet should not loose suction at any time.

In open sea, vessel is normally in auto pilot. It is advisable to change over to hand or manual control to avoid excessive hunting of the <u>rudder</u>. Moreover, one person should go and check all the oil levels, linkages and other important parameters of the steering gear in the steering room. If one motor is running, switch on other motor and run both of them together to get maximum available torque to turn the rudder.

If the engine room is on UMS mode, man the engine room and make sure sufficient man power is available.Monitoring all the parameters of the main propulsion plant and auxiliary power plant machineries.After getting rough weather warning, all the spares in the engine room are to be stowed and lashed properly.

In bad weather, propeller will come in and out of water and will fluctuate the main engine load. Hence rpm is to be reduced or main engine control setting is to be put on rough weather mode.

It is obligatory for the engine department personnel to make sure for correct sump level of all the machineries as during rough sea ship will roll, resulting in false level alarm which can even trip the running machine and lead to dangerous situation in bad weather.Stand by generator is to be kept on load until the bad weather situation stops.

Water tight doors in the machinery spaces must be closed as well as sky lights and other openings.

In addition to safety measures to be taken when operating the ship and maintaining her machinery, much attention should be paid to safe working practices.All trays are to be avoided from spilling in event of rough weather. It has to be instructed to the crew not to go out on open deck in rough weather.All the deck items like mooring ropes, lashing equipment, drums etc. shall be stored and lashed properly after their use.All openings in the deck for cargo and other spaces shall be kept shut.All opening to the accommodation shall be kept closed.Shaft tunnel and other internal access space are to be used to go to steering room or other compartments.Elevators shall be switched off as during rolling and pitching trip may occur and can cause trapping of the person inside.
Everyone must be aware of his/her duties posted in the muster list. It is required for the crew members to wear all thepersonal protective equipment and use railings and other support while walking through any part of the ship to avoid trips and fall. As rough weather conditions pose a critical threat to both the ship and her crew the personnel shall be alert and work in team [2].

Despite extreme weather conditions, shipping is predominantly used for carrying out the transportation of goods and raw materials. Technological and scientific research projects are conducted to discover and develop procedures and devices assisting in enhancing safety at rough sea.

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METHOD FOR CONDUCTING AN EXPERIMENT IN A HYDRODYNAMIC TUBE OF A SHIP'S RUDDER WITH JET CONTROL

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Аннотация: Целью данной работы является экспериментальная проверка результатов расчетных операцийдля повышения маневренности судов на малых и предельно малых скоростях хода. Теоретическая часть расчета руля с использованием аэродинамической теории крыла с большой точностью определяет силы, возникающие при течении воздуха или жидкости, рассмотрены в работах.

Ключевые слова: гидродинамическая труба, двигатель постоянного тока, гребной винт, трубопровод, подвод сжатого газа, гидрофор.

Annotation. The purpose of this work is the experimental verification of the results of calculation operations in order to increase the maneuverability of ships at low and extremely low speeds. The theoretical part of the calculation of the steering wheel using the aerodynamic theory of the wing with great accuracy determines the forces arising during the flow of air or liquid are considered in the works

Keywords: hydrodynamic pipe,DC motor, propeller screw, pipeline, supplying compressed gas, hydrophore.

Introduction

The purpose of this work is to develop an experimental methodology for evaluating the efficiency of the steering device with jet mechanization [2, 3, 6, 9, 12, 13].

Frequent rudder shifts are necessary to keep the vessel on course. Even if the ship is stable on the course, then at the slightest disturbing influences it is necessary to shift the rudder to small angles to stabilize on the course. At low ship maneuvering speeds, the efficiency of the rudder is very low. All this leads to additional power consumption for the drive of the steering gear pumps. Electricity consumption entails an increase in fuel consumption for the operation of diesel generators [8].

In the port water area, in narrow places, the ship needs increased maneuverability.Modern ship's heading control systems tend to operate in dependence on rudder disconnection, which causes large deflecting moments and a constant yaw in the ship's heading. As a result, an additional amount of fuel is spent to compensate for these fluctuations, especially in stormy conditions, with strong winds and sea currents [1].

One of the promising ways to maneuver a ship at low and extremely low speeds, as well as reduce fuel consumption, is the use of jet mechanization of the ship's rudder - pouring liquid jets under pressure onto the suction surface of the rudder and ship's hull in the bow. The proposed control method makes it possible to eliminate the oscillation and create smooth control at low energy losses and, accordingly, reduce fuel consumption [5, 11]

Conducting an experiment

After starting the pipe, bring the engine (propeller) speed to low mode.

Measure the velocity of the fluid flow in the pipe, while the steering wheel, without blowing air (to the left) of the fluid, set to zero. Using the monometers, determine the zero position (i.e., there is no deviation of the rudder from the hydrodynamic forces to the left or to the right). Set the rudder deflection to the right by 10 degrees and use the monometer to determine the hydraulic pressure created by the fluid flow. At a given flow rate, measure the hydraulic pressure at two more points at a rudder deflection of 10.15 and 20 degrees.

Bring the speed of the drive motor (propeller) to the average mode and measure the fluid flow rate in the pipe. Determine the pressure from hydrodynamic forces using the monometrics for three rudder deflections of 10.15 and 20 degrees.

Calculate the hydrodynamic forces based on the obtained pressure values measured by a monometer, taking into account the geometric characteristics of the hydraulic cylinders.

Instrument control

Power is supplied from shield No. 8 by turning on the knife switch. To supply power to control devices, turn on the start button on the AP-50 board - the green lamp on the power board will light up

The stand is equipped with:

Speed sensors (2pcs)

Control recording apparatus, consisting of a power supply, an oscilloscope, a temperature and pressure measurement unit.

Turn on shield No. 8 for power supply of measuring equipment

Supply power to the HDT control panel by turning on the package 1 and the starter button (black) 380 V on the wall by the window by pressing the start button(power will be supplied to the DC rectifier-transformer, 127V on the voltmeter on the HDT panel)

Open the main shield of the gas turbine engine and by pressing the starter button No. 1 AP-50, check the position of the rheostat (to the limit counterclockwise) connect the power to the generator excitation rheostat (DG). At the same time, we control the supply voltage on the voltmeter rectifiers of generator No. 4. Excitation current can be monitored on ammeter #3 (current is initially zero)

By pressing the starter button No. 2 AP-50, supply power to the excitation winding of the electric motor, while on the front panel the green lamp lights up signaling the power supply to the motor (shunt winding operation)

With bag # 1 below, we switch the polarity of excitation of the generator (the handle of the bag with a red tip: left - right rotation, right - left rotation)

To determine the voltage of the generator during right rotation, turn on Bag No. 2 at the top (the red arrow is to the left, with left rotation the red arrow is to the right)

We start the DC diesel generator DG-2 (yellow) Check the absence of foreign objects on the DG Prepare water cooling system Prepare the fuel system Prepare the oil system Pump oil with crankshaft rotation 2-3 turns Open the air cylinders and supply air to the engine Crank the diesel using the air system Close indicator valves and start engine

At the same time, control the oil pressure in the system, the cooling system of the 1st and 2nd circuits, engine speed (according to the tachometer, they should be 750 rpm)

Set the required voltage with a rheostat

Further control is carried out by a control rheostat (Initial moment - control handle to the limit counterclockwise). When turning the handle of the rheostat clockwise, we monitor the increase in the excitation current of the generator (ammeter No. 3). The engine speed is increased by turning the rheostat control knob clockwise. Turnovers are controlled by a mechanical speed meter on the axis of the electric motor, a speed counter on the device installed on the rack on the right.

Conducting an experiment in a hydrodynamic tube

The Boundary Layer Control System (BLCS) is designed to affect the boundary layer in order to prevent its separation on the ship's rudder, and to increase the bearing properties of the rudder by creating additional circulation.

Compressed air or liquid jets are blown out of slotted nozzles along the tangent to the streamlined surface with a minimum intensity sufficient to ensure an unseparated flow around.

Air is supplied from compressed air cylinders located near the hydrodynamic tube. The liquid is supplied from a hydrophore located inside the pipe (see Fig. 1 - 2)



Figure 1- Hydrodynamic tube device

1 - hydrodynamic pipe;2 - viewing windows;3 - shafting;4 - hydrophore;5 - DC motor;6
propeller;7 - pipeline for supplying compressed gas to the hydrophore;8 - pipelines for supplying water to the hydrophore and to the pipe;9 - pipeline for draining water from the hydrodynamic tube;10 - electric motor control panel;11 - connecting flange of the hydrodynamic pipe;12 - supporting foundations for pipe installation;13 - liquid pressure gauge;14 - fluid pressure gauge in the pipe to the propeller; 15 - hydrophore air pressure reducing valve;16 - fine filter for water entering the hydrophore;17 - experimental stand for the study of the steering wheel with jet mechanization;18 - hydraulic cylinders



Figure 2 –Hydrodynamic tube

When blowing (pouring) gas, liquid onto the suction surface of the rudder deflected at a certain angle, its efficiency increases and at large deflection angles, from the trailing edge - its hydrodynamic characteristics improve, the lifting coefficient increases (lateral force also occurs due to a change in the momentum coefficient of the CMR jet)

Jet momentum coefficient CMR = K •tg δp where K = 0.015 - 0.045 imperial coefficient δr - rudder deflection angle

The smallest CMR values are achieved with relatively small dimensions of the target nozzle R = 0.015 at hc hc/b \approx 0.05% with a chip width of 0.5–0.7% of the profile chord, the coefficient increases to 0.040–0.045. The most important factor limiting the attainment of lift limits is the viscosity of the flow.

The influence of viscosity manifests itself in the deceleration of the flow on the streamlined surface, which leads to a distortion of the "effective" contour of the airfoil, slowing down the flow and breaking it in the diffuser (tail) part of the airfoil due to an unfavorable (positive) pressure gradient.

Thus, the possibility of obtaining large values of the lift coefficient by changing the curvature and angle of attack is limited by the occurrence of a disconnected separation region, which has a significant effect on the aero and hydrodynamic characteristics of a rudder with a large curvature, despite the preservation of an unseparated flow directly on the rudder.

Experiments show that an increase in the relative curvature of the rudder with a deviation (Fig. 3) of the rudder profile tips can significantly increase the lifting coefficient (lateral rudder force $\delta_3 \leq 30^\circ$, f max ≈ 0.19) in relation to a conventional rudder by 2 - 2, 5 times. In this case, the experimental values of Cy are closer to the calculated ones.



Figure 3 - Jet rudder with two profiles: 1 - jet blowing; 2 - deflected toe, streamlined by a jet formed

The flow around a rudder with a deflected toe is practically continuous in a wide range of angles of attack [5, 7, 11]. Deflection of the toe of the steering wheel at angles $\delta z = 25^{\circ}$, the largest value of the lifting force coefficient at $\alpha = 10^{\circ}$, Cy = 26 is achieved with a relative curvature f max ≈ 0.25

At $\text{Re} = 2.5 \cdot 106$ (M = 0.15), a high increase in lifting force is achieved. The use of a deflectable toe on the rudder is assumed together with tangential blowing of the jet on the toe of the main part of the rudder.

The boost intensity is controlled by changing the air (liquid) pressure in front of the nozzles and is characterized by the value of the jet momentum coefficient:

$$C_{\rm M} = \frac{mc \cdot Vc}{g \cdot s}$$

where: mc - mass air flow per second,

Vc - jet flow velocity

 g^{∞} - velocity head of the oncoming flow

S - rudder area

A jet rudder with two profiles to increase the lift force on the rudder (in this case, lateral force) is a jet-mechanical system consisting of a main part with one deflected rudder tip.

The rudder, when deflected, forms an ejector displacement chamber, into which a jet of compressed air or liquid is supplied through the target from the increased discharge zone to the low pressure side onto the suction surface of the deflected rudder tip.

As a result, the lift (lateral force of the rudder) increases due to the effect of suction of the boundary layer from the surface of the rudder and the target deviation of the toe of the rudder and the effect of supercirculation and the reaction of the jet blown out of the system increase

Conclusion.

Blowing jets of compressed air (liquid) from slotted nozzles onto the suction surface of the ship's rudder from its leading edge gives an increase in lift due to an increase in the energy of the boundary scrap, the creation of an unseparated flow around the surface of the rudder at large deflection angles and an increase in flow circulation.

When blowing onto the suction surface of the rudder with an intensity sufficient to restore a non-separated flow around (Cmn $\approx 0.04 - 0.15$ at deflection angles of 45°), the theoretical values of the lifting force coefficient of the moment for turning the vessel and reducing the inductive resistance together with the transverse blowing on the lower and the upper cuts of the

rudder, determined by the theory of the bearing surface in the flow, is an ideal liquid.

Blowing out jets from the target nozzle along the trailing edge of the rudder at angles to its chord improves the load-bearing properties of the rudder by creating an additional hydrodynamic load on the rudder (the effect of supercirculation and reaction from the deflected jet).

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THENEGATIVE EFFECT OF SHIPOWNER'S COST CUTTING ON THE SAFETY OF NAVIGATION

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Аннотация. Безопасность человеческой жизни на море – одна из важнейших задач в процессе эксплуатации водного транспорта. На ряду с развитием технического прогресса и автоматизации работы на флоте, судовладельческие компании стремятся сократить численность экипажа в целях экономии средств. Кроме того, экономия сказывается на общем состоянии судов и на их эксплуатации: стремление сократить расходы на ремонтных работах и привлекаемых специалистах влияет на безопасность мореплавания.

Ключевые слова: сокращение экипажа, безопасность мореплавания, усталость экипажа, человеческий фактор в судоходстве.

Annotation. The safety of human life at sea is one of the most important tasks in the operation of water transport. Along with the development of technological progress and automation of work in the fleet, ship-owning companies are trying to reduce the number of crew in order to save money. In addition, the savings affect the general condition of ships and their operation: the desire to reduce the costs of repairs and specialists involved affects the safety of navigation.

Keywords: crew reduction, safety of navigation, crew fatigue, human factor in shipping.

Introduction.

Of course, at present any ship-owning company aspires to increase the profits received from ships. But at the same time not everyone tries to combine this with the safe work of the crew. Every year the operators of the merchant fleet are trying to save money, reduce costs, optimize work in such a way as to incur minimal costs. As a result, such optimization can negatively affect the safety of navigation and work on ships.

The main part.

Companies that own their own fleet are trying, in general, to reduce the cost of the ship itself and the crew.

Currently, as far as Russia is concerned, the country is under sanctions pressure. This has greatly affected the financial component of any company in the country. A huge part of the fleet operating in Russia was built at foreign factories, that is, all the ship's components, parts, engines and any other equipment are also foreign-made. Conditionally, when a mechanism fails, the shipowner is forced to look for ways to replace it, which is currently quite difficult or very expensive to do. This leads to the search for cheap analogues, which are often short-lived or even not safe. The decommissioning of the vessel during the repair period also leads to additional costs, since the vessel does not make a profit.

If we talk about the repair of ships, Russian companies are increasingly trying to save not only on materials, but also on the labor force involved for this. As you know, in case of breakdowns or planned repair work, shipowners try to put some part of the work on crew members, this is especially common practice in the river fleet. In this case, many tasks can be performed by incompetent people, not professionally and unsafe.

In addition, shipowners are trying to reduce the cost of ship repairs by any means: saving on the quality of materials, on the reliability of equipment, on the pace of work, and so on. Such savings lead to rapid wear of the vessel, which is unsafe and entails even greater expenses for subsequent repairs.

In some companies, the situation of saving on crew members is very deplorable. First of all, there are many cases when companies try to reduce the cost of crew meals by purchasing cheaper products, which affects the seaman's performance. Despite inflation, which increases every year, the cost of seafarers' meals does not always increase with it, sometimes this amount remains unchanged with rising prices.

Currently, there is a tendency to reduce the number of ship crews, which undoubtedly cannot affect the safety of navigation, despite the high level of automation. Shipowners are trying to reduce the number of people on the ship, while the amount of work at sea does not decrease. On the contrary, the company's requirements for reporting, documentation, and so on often increase. With a reduced staff, the load on each employee increases, working hours increase, rest time decreases, which leads to human fatigue, and as a result, accidents occur.

To achieve effective work, a balance must be found between excessive or insufficient staffing of the crew. Fatigue is affected by a number of factors: this is the amount of work, personal perception of risk or interest in the task being performed, as well as the time of day: for example, mindfulness decreases to an extremely low value in the period from 3 to 5 in the morning. The degree of fatigue may be partly influenced by lack of sleep and insufficient water intake.

To date, the number of crews of sea vessels has been reduced to a minimum, of course, the fatigue of an understaffed crew increases significantly. Plus, the crews work for several months without a break, flights, on average, last from three months or more. At the same time, a person begins to get tired after two months of work on the ship. The second reason is that on modern ships there are less than three watch assistants, this is the necessary minimum. People do not have time to get a full rest. And the third is the increase in the amount of paperwork, the seaman has to constantly fill out documents, write reports, various reports necessary for verification by various kinds of inspections, which are strictly exacted if they are not issued on time.

While on watch, it is impossible to fill them, so you have to do it at another time – rest time. Thereby tearing away precious hours from him, which could be spent on recuperation and sleep.

In March 1989, a terrible disaster occurred off the coast of Alaska – the «EXXON VALDEZ» tanker was stranded. As a result of the accident, about forty million liters of oil spilled into the sea, the oil slick spilled about 28 thousand kilometers. Colossal damage has been inflicted on the natural infrastructure for many years, not to mention huge economic losses. As a result of the investigation, it was revealed that the third mate and the sailor, who were on watch, did not have the opportunity to rest the prescribed 6 hours before the twelve-hour watch.

According to the UK Maritime Accident Investigation Bureau (MAIB), 82% of accidents related to stranding are caused by crew fatigue in the period from 2 to 6 in the morning. If there are less than three officers on watch, then such a vessel is at risk, since preparation and port calls, cargo operations and other tasks require their constant attention.

Along with the reduction in the number of crew, it is necessary to distribute the watch time between the watch assistants, therefore, many companies set a schedule of 6 hours of watch / 6 hours of rest. With this mode of operation, a person accumulates fatigue after fourteen days, which greatly affects the efficiency and attentiveness of a person.

In 2008, the cargo vessel«ANTARI» ran aground off the coast of County Antrim due to the fact that the overworked mate fell asleep on watch. According to the entries in the ship's log, the crew as a whole was overworking and did not have enough time to rest.



Fig. 1 - The «ANTARI» ran aground just north of Larne, County Antrim

Conclusion.

Despite the negative experience of previous years, staff reduction is the most widely used method of reducing crew costs, but most often it is achieved by forcing crew members to overwork. Such measures have a negative impact on the general condition and human health, as a result, and on safety.

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MODERN NAVIGATION AIDS ON THE SHIPS OF THE RUSSIAN FEDERATION

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Аннотация. В статье рассматриваются современные средства навигации, их значимость и история развития. Представлены основные проблемы в области навигации на судах и перспективы их развития, а также даны требования к оборудованию и рекомендации по его использованию. Особое внимание уделяется законодательной и нормативно – технической базе.

Ключевые слова: средства навигации, судно,принцип работы, перспективы развития, законодательный и нормативно – технический базис.

Annotation. The paper studies modern navigation aids, their significance and the history of development. The main problems in navigation and their development prospects are given. The requirements to the equipment and recommendations on its usage are presented. Special attention is given to legislative and regulatory technical basis.

Keywords: navigation aids, ship, principle of operation, development prospects, legislative and regulatory- technical basis.

Introduction. Modern navigation aids on the ships of the Russian Federation are crucial for ensuring safe navigation and efficient vessel management. The development of navigation technologies and systems allows to master the work of ship's crews and improve the quality of transportation. The history of navigation development on ships in Russia as well as modern navigation aids, their peculiarities and application on board are considered in this paper. Legislative and regulatory- technical basis, requirements for the equipment of the ships and operational features of navigation aids are discussed. Moreover, the main problems concerning with ship's navigation in the Russian Federation and development prospects of navigational technologies on ships are analyzed.

From the history. The developmental history of navigation aids is more than three centuries. The first navigation aids are appeared in 17th century. During this period the most commonly used navigation aids were compasses and quadrants which were used for defining the ship's course and position.

In the 18th century, instruments to navigation became more precise and advanced due to the development of scientific and technical knowledge. Sextants, clinometers, logs, and other devices appeared during this period, which allowed to define the ship's position and speed more precisely.

In the early_19th century, electronic devices replaced classic navigation instruments. In 1905 the first radio navigation lighthouse was established on the Neva river in Russia. In the 1930s the development of radio navigation system which later was called as 'GLONASS system' began. The

development of inertial navigation systems which were widely used on naval and civil ships was in the USSR in the 1960s.

In the 1990s, the Russian Federation began to develop its own version of the global positioning system called GLONASS. This system was put into operation in 1993 and it has been improving up to now. In the 2000s, Russia began cooperating with other countries in the navigation systems development. The navigation system Galileo was created in cooperation with European Union.

Nowadays modern and accurate aids of navigation which provide high security and efficiency of navigation are used on Russian fleet ships.

Up- to – date aids to navigation are indispensable to safe navigation and efficient operation of maritime transport. Thus, the most commonly used and important aids to navigation will be described in the paragraph below [5]:

1. Satellite navigation systems

GLONASS is a Global Navigation Satellite System which was developed and launched by the Russian Federation. This system includes 24 operational satellites and provides high precision and reliability in defining the ship's position.

GPS is an American global positioning system. It consists of 31 satellites and it is one of the most popular navigation systems in the world. There are other different systems of navigation such as Galileo (Europe), Beidou (China), QZSS (Japan), etc [2].

2. Inertial navigation systems

The operation principles of inertial navigation systems (INS) are based on the use of the principles of inertia and angular position. INS provides a high degree of accuracy in navigation and is used by a majority of modern ships. There are different types of inertial navigation system such as gyrocompasses, indicators, gyroscopes and others.

3. Radio navigation systems

Loran –C is a radio navigation system which is used to define the ship's position based on the radio station signals. Decca is a radio navigation system developed in the UK. It uses several frequencies for defining the ship's position. Omega is a radio navigation system developed in the USA. This system uses broad band signals and it is one of the most accurate radio navigation systems. There is a number of other navigation systems such as: CHAYKA, CONSOL, LORAN – A and etc [1].

4. Automatic identification systems (AIS)

AIS is an automatic identification system which is used for defining the ship's position and identification of ships at sea. It allows vessels to exchange the information regarding the ship's position, course and speed due to this it increases the safety at sea. There are other automatic identification systems known as SART, ARPA and etc.

5. Echo sounder. The principle of operation

The echo – sounder is used for depth sounding of the sea. The system works on time measurement basis which is required for sound signal to pass from the ship to the seabed and come back to the ship. There are various types of echo- sounders such as single- and multipath, with a fixed or mobile antenna having different frequencies.

6. Radars. Operation principle

The radar is used for detection of other vessels, objects and various obstructions at sea. This system is based on the electromagnetic wave radiation and period of time which is required for their reflection from the objects and returning to the receiver. The most famous types of radars are X-band, S – band and C- band antennas [4].

7. Other navigation aids

Compasses are used to define the ship's route. There are different types of compasses: gyro, magnetic and electronic compasses.Logs are used for ship's speed measurement. On board modern ships you can find mechanical, electromagnetic and unltrasound logs.

Nowadays, GPS navigation is one of the most popular aids to navigation on board ships. The system works on the basis of a satellite signal, which allows to define the position of the vessel with high accuracy. We must mention about integrated navigation systems that combine several different aids to navigation and provide more exact and reliable ship's position and course [9].

The peculiarities of navigation aids usage on ships in the Russian Federation

Legislative and regulatory- technical basis means the use of navigation aids on board ships and is subjected to the law and regulatory – technical documents such as the Rules for the Classification and Construction of Sea-Going Ships, the Rules for the Classification and Construction of Inland Waterway Ships, the Rules for Registration and Issuance of Permits for navigation of Small Vessels and Other Vessels up to 24 meters, Rules for the construction and safe operation of electronic equipment etc [7].

It is necessary to comply with specified facility requirements which are given in regulatory documents for the use of navigation aids in the Russian Federation. Every ship must have radars, echo- sounders, GPS, AIS, logs and etc.

Due to climatic and geographical conditions in Russia the operation of navigation aids can be accompanied by a number of problems such as strong magnetic fields in the north of the country, poor visibility due to fog or ice, as well as the number of rivers and canals with shallow depth can impede the navigation.

Navigation safety measures are closely connected with the application of navigation aids including equipment quality management and staff competence, carrying out of regular inspections and ship's maintenance. Thus, the usage of navigation aids on ships in Russia requires to comply with certain statutory and regulatory requirements as well as taking into account specifics of operation in waters surrounding Russia.

Speaking about problems and prospects concerning with the development of navigation aids it should be noted that there is a number of problems associated with the use of these navigation aids. They are:

1. Technical problems which include disadvantages in operation of the equipment, disfunction of GPS and geo-positioning signals, insufficient measurement accuracy, problems with data transmission and others.

2. Staff problems are connected with the lack of well- qualified personnel, insufficient readiness to work with new technologies and due to the low level of education.

3. Underinvesment. The development of new navigation technologies requires significant financial investments, the lack of which is felt regularly. In spite of these problems, the development of navigation technologies in Russia doesn't stop.

Among the main development prospects we can distinguish the following:

1. The improvement of existing technologies which is carried out due to the accuracy increase, reliability and efficiency of navigation systems on the ships.

2. The development of new navigation systems which can considerably increase the efficiency and safety navigation at sea is performed.

3. Integration with other systems. The development of navigation technologies on ships cannot be considered in isolation from the development of other related systems, such as ship control automation, etc.

Thus, the development of navigation technologies on ships in Russia is an important task that requires an integrated approach and significant financial investments. However, due to innovative technologies and well – qualified personnel, the solving of these tasks is possible and can cause to safe and efficient operation of ships.

Conclusion. Modern aids to navigation, the history of navigation technologies development as well as peculiarities of useof these navigation aids were considered in this paper. It is found that legislative and regulatory-technical basis in Russia provides a high level of safety when using navigation aids on ships. However, there are problems connected with the

necessity of technical means updating and improvement of the staff qualification. Speaking about the development prospects of navigation aids on ships it was noted that innovative solutions in electronic navigation such as ship autonomous control system will considerably improve the efficiency and safety of navigation. It is recommended to carry out additional studies in innovative technologies and continue improving of legislative and regulatory- technical basis in navigation.

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SECTION 5: THE ACTUAL PROBLEMS OF ECONOMICS



UDC 330.341.1 ASSESSMENT OF THE POSSIBILITY OF FULL IMPORT SUBSTITUTION IN THE FIELD OF DIGITALIZATION OF THE ECONOMY

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Аннотация. Предлагаемый аналитический обзор посвящен вопросу импортозамещения электронных программно-технических устройств в связи с угрозой для национальной безопасности. Рассмотрены основные проблемы, возникающие при внедрении изменений в действующую производственную систему, а также способы их решения и преодоления трудностей. В настоящее время разработка устройств, собранных на велется отечественных Это снижает риски дальнейшего влияния на комплектующих. внутреннюю экономику страны путем ограничения поставок оборудования.

Ключевые слова: экономика; терминалы; оборудование; импортозамещение; отечественные компоненты; разработки.

Annotation. The proposed analytical review is devoted to the issue of import substitution of electronic software and technical devices in connection

with the threat to national security. The main problems that arise when introducing changes to the current production system are considered, as well as ways to solve them and overcome difficulties. Currently, the development of devices assembled on domestic components is underway. This reduces the risks of further impact on the domestic economy of the country by limiting the supply of equipment.

Keywords: economy; terminals; equipment; import substitution; domestic components; developments.

Nowadays, there are significant changes in the field of communications and information dissemination. Digital technologies unite all spheres of life. All developed countries in their history face the need for digitalization in the fields of politics, economy, culture, social processes and others.

At the moment, a progressive information environment of digital communication systems is being formed. As its primary basis, we can single out the use of digital currencies, the transfer of economic ties to a digital basis, the reduction in demand for developed transport infrastructure and the reduction of business costs.

Digitalization is a transition to more modern models that are based on information technologies. This is an economic activity that is based on the creation, distribution and application of digital technologies, as well as related products and services.

The financial industry is a leader and at the same time the main engine of digitalization, which is manifested in the development of online banking, electronic payments, crowdfunding, scoring models for assessing credit risks, investment robot advisors, cloud storage of information, cryptocurrencies, blockchain, P2P lending [9].

Each of these industries is exposed to vulnerabilities directly related to the safety and stability of equipment. The use of any foreign-made equipment carries a fairly high degree of vulnerability to users in a political situation. The manufacturer reserves the elements of control over the operation of the equipment.

Almost all modern equipment that is exported contains software or hardware additions. Without the help of the manufacturer itself, it is quite difficult to find such additions. And such additions are a "time bomb" that the manufacturer can initiate at any time. If their owner decides to cause damage to the organization, he has the opportunity to do so. The consequences can be disastrous not only for individual organizations, but also for entire sectors of the economy, especially in the conditions of digitalization [2].

This vulnerability can be eliminated by limiting the share of foreign equipment and supporting domestic developers. Operating systems certified by the FSTEC of Russia and the FSB of Russia, included in the Unified Register of Russian Computer Software and Databases, are already presented on the Russian market. They are able to work on computers with Russian Elbrus processors. The architecture of this processor is designed by domestic engineers and is steadily developing every year. To build a trusted digital hardware and software environment of the Russian economy, it is necessary, in addition to the processor, to have a domestic operating system [4].

An equally important aspect of information security is ensuring a long period of relevance and operability of the domestic processor and operating system. Due to the political situation, foreign importers do not give guarantees about the performance of their products in Russia in the near future. In turn, Russian software will be available under any conditions of the political map of the world.

In connection with the adoption on January 17, 2020 of a new strategy for the development of the electronic industry of the Russian Federation for the period up to 2030, the developer of Russian MCST processors increased the volume of contracts with potential consumers of products. There was information about the company's plans for the future. However, due to the events of 2022, the company faced significant problems. The Elbrus family of Russian processors was produced in limited batches at TSMC's Taiwanese factories. The strategy for the development of the electronic industry sets the goals of creating conditions for the full production of processors in the country [8].

Today, a processor can be created in three ways:

1. To purchase a project license for the release of a ready-made core project from a foreign company and use it when developing their processor, the developers of the Russian Baikal processor followed this path. Thus, the state does not solve the problem of vulnerability of imported components.

2. Purchase an architectural license for the right to develop a processor with an appropriate command system (this is how the MCST-R processor line is made, licensed by Sun). You can also take a freely distributed architectural license (for example, RISC-V).

3. Independently develop a command system. The creators of the Elbrus processor followed this path. The most serious and technologically independent way, in which even in the case of revocation of licenses for secondary modules, the most important thing is preserved — the command system, that is, the entire ecosystem of software developed for this processor is preserved. In case of problems with licenses, any secondary modules can almost always be replaced, and this will not affect either the operating system or the application programs.

Thus, Elbrus has a Russian core architecture and a Russian command system. This really solves part of the problems of information security. In

addition, the architecture of the so-called broad command word gives a performance gain.

Recently, due to information security problems, it was planned to transfer the banking system to Russian equipment. Part of the server part of some banks has already been transferred to domestic components. One of the suppliers of foreign terminals started its production of ATMs, and the Ministry of Industry and Trade financed it, among others. Not all ATM components can be replaced by Russian ones [10].

Large Russian banks, some of which fell under the sanctions policy, planned to start purchasing domestic ATMs as soon as they begin to be produced. Currently, only foreign ATM manufacturers are represented on the Russian market. Already in 2022, according to a government decree, the share of Russian products in the procurement of such devices should be at least 20% for banks with state participation. The self-service devices were supposed to have a domestic processor "Elbrus", it was planned to start production in early 2023.

In addition, at the first stage of import substitution, it was planned to use Russian design, documentation, case elements and Russian software in the form of the Linux operating system. The cash recognition and processing module, as well as a number of other components, should remain foreign. The company planned to replace the remaining foreign elements in ATMs for several years.

However, the manufacturer of the domestic processor "Elbrus" had difficulties. Previously, these processors were assembled in Taiwan, but now he has decided to close their production. Now the developer of these processors plans to transfer their production to the Russian Micron plant, but this may take time, which will slow down the processes for the production of equipment based on Elbrus.

The capabilities of "Elbrus" for the operation of ATMs would be enough if this processor was still produced in foreign factories. But since its release is now suspended, it is impossible to assess the processor's performance.

Domestic processors are produced according to different technical processes — from 130 nm to 16 nm. The Micron company has the opportunity to produce chips using 90 nm technology, but in this case it will have to abandon more modern processors. At the same time, there are other problems that do not allow the domestic factory to enter full-fledged serial production [6].

There is a very high degree of probability that modern processors will have to be abandoned. At the moment, Micron can produce chips using 65nm technology, but in the case of MCST, only a 90-nm process technology will be available. Unfortunately, in this case, the range of tasks that domestic chips can perform will be quite narrow. These are communication systems, thin clients, cash registers, etc.

In turn, Russian buyers of processors and equipment where they are installed were not very happy with the results. Sberbank at the end of last year tested two types of servers with a domestic processor "Elbrus". In the course of the study, it was concluded that these systems will not be able to be implemented into work.

In addition, domestic systems and state-owned companies were criticized, which were dissatisfied with the high price, not very high performance and low energy efficiency of chips and equipment [7].

Domestic chips will find their buyer, for those tasks where particularly high performance is not needed. Additionally, it is possible to configure software for domestic systems to obtain maximum performance from the chips. But the range of tasks that will be solved in this case will not be particularly extensive.

The problem of the cost of chips lies in the volume of batches of products. To reduce the price, it is necessary to increase production volumes. It is now possible to do this only with the help of the state as the main customer of the products. Micron will be able to double the volume of production of silicon wafers by 2025 [5], but still these are not the indicators that will significantly cut the cost of the chip.

The problem with the outdated technical process will be solved, but not in the next year or two. Despite this, there is a construction site in Zelenograd, where work on the construction of the factory has started. According to the plan, it will produce processors using 28-nm technology, which will be used to assemble domestic electronic devices of various types. Undoubtedly, this will help protect economic sectors during the period of digitalization. The construction is scheduled to be completed at the end of 2024.

The funds allocated for the development of the industry will be distributed in four main directions — for the development of infrastructure, domestic electronic products, increasing demand for it and the personnel component.

As one of the types of support, the government can recognize Baikal Electronics and MCST as system-forming enterprises. Such a measure is necessary in order to help enterprises transfer direct chip production from Taiwan to Chinese factories.

Backbone enterprises are companies that have a significant impact on the development of the country's economy. Such enterprises provide the greatest employment in their industries and are the largest taxpayers. These enterprises can count on subsidies to reimburse the costs associated with the production of goods, works or services. They will also be provided with a tax deferral and state guarantees on loans or bond loans [1]. Such support measures were taken for system-forming organizations as anti-crisis and operated in 2020 against the background of the coronavirus pandemic. At the beginning of March 2022 The Government has resumed its support program. In the new version, it is designed not only for those companies that have suffered from the coronavirus, but also for those who have fallen under the influence of unfriendly actions and sanctions of foreign states, according to the Government decree of March 6, 2022.

Among other proposals, in addition to including design centers in the list of strategic enterprises, there is a return of the targeted distribution system to universities that produce specialists in the field of radio electronics. At the moment, only 5-10% of graduates of specialized universities work in their specialty. It is planned to encourage them to stay in the profession, to cooperate with manufacturing enterprises, to send students to practice at specific production facilities so that they learn to work on specific equipment.

Due to the penetration of digital technologies into all new areas of human life and activity, information security issues are playing an increasingly important role, including computing security, protection from various kinds of failures and errors, as well as data protection from unauthorized interference. Against the background of the aggravation of the international situation, the importance of protecting computing and data from unfriendly interference is only increasing.

The Russian school of computer technology developers inherited from the USSR the tradition of paying special attention to the security of computing, which was initially associated with the development of highly efficient air defense systems, and later embodied in the architecture of Elbrus processors. The development of this line of research does not stop, although it is difficult. As a result, we currently have the most secure processors in the world, the architecture of which is developed in Russia, but the chips are manufactured in Taiwan. This situation is quite typical, many firms place orders for the production of microchips there, but the production of the entire product inside the country could provide greater security.

The presence of a scientific school that allows us to develop the safest processors in the world gives Russia a chance to participate in the race for leadership, at least in those areas of computer technology applications where security is the main criterion.

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UDC 338.001.36

SECTION 6: PHYSICS, BIOLOGY, ASTRONOMY AND ECOLOGICAL PROBLEMS



UDC 504.3.054

AIR QUALITY IN SEVASTOPOL Voctoria Dyulo, Valentin Godyna 2nd year students, Technospheric safety Department Sevastopol State University Scientific advisor, Alla Mikhaylova senior lecturer, Foreign Languages Department Sevastopol State University

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Аннотация. Концентрация PM2.5 является основным параметром для оценки качества воздуха и его влияние на человека. По нормам BO3 среднегодовой уровень PM2.5 должен составлять не больше 10 мкг/м3, а среднесуточный уровень не больше 25 мкг/м3.Авторами определено, что Севастополь входит в рейтинг городов по загрязнению воздуха.

Ключевые слова: кислород, кристаллический диоксид кремния, концентрация PM2.5, CEMDT-9881.

Annotation. The concentration of PM2.5 is the main parameter for assessing air quality and its impact on humans. According to WHO standards, the average annual level of PM2.5 should be no more than 10 μ g/m3, and the average daily level should not exceed 25 μ g/m3. The authors determined that Sevastopol is included in the rating of cities in terms of air pollution.

Key words: oxygen, crystalline silicon dioxide, PM2.5 concentration, CEMDT-9881.

Introduction. Air is what everyone breathes every day, and the state of the environment around us, animal health and, of course, human health depend on its quality. Over the past decades, the share of emissions from cars and trucks has increased significantly. In large cities, motor vehicles account for 30 to 70% of the total mass of emissions [8]. Despite the fact that currently, people began to use electric vehicles more, this did not solve the problem of reducing air pollution and the environment in general. "Electric cars are not associated with real-world reductions in both air pollution and respiratory problems" [6].

"Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Household combustion devices, motor vehicles, industrial facilities and forest fires are common sources of air pollution. Pollutants of major public health concern include particulate matter, carbon monoxide, ozone, nitrogen dioxide and sulfur dioxide" [1]. Many scientists have argued that air quality affects a person's lungs (H. Hammad, B.N.Lambrecht, P.E. Pfeffer,S hin S., Zhang Z., Y. Zhu, Z. Pan, D.Jing , H. Liang et al.).[1, 5, 7, 10, 11]. **The purpose** of the article is to describe air quality in Sevastopol.

The main part. Air quality is linked to the earth's ecosystems and climate globally. The following Air Pollution Levels are good, moderate unhealthy, unhealthy, veryunhealthy, hazardous (picture 1).

AQI	Air Pollution Level	Health Implications	Cautionary Statement (for PM2.5)
0 - 50	Good	Air quality is considered satisfactory, and air pollution poses little or no risk	None
51 -100	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
101-150	Unhealthy for Sensitive Groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.
151-200	Unhealthy	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects	Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit

Source: World's Air Pollution: Real-time Air Quality Index [9].

The Air Quality Index is based on particulate matter measurement (PM2.5 and PM10), Sulfur Dioxide (SO2), Nitrogen Dioxide (NO2), Ozone (O3), and Carbon Monoxide (CO) emissions. The stations are monitoring

both PM2.5 and PM10 data, but there are few exceptions where only PM10 is available (picture 2).



Picture 2 – Air Pollution Levels on the map

The human respiratory system is the first to suffer from poor air quality, as dirty air enters through the respiratory tract, which then enters the lungs and saturates the blood with oxygen. Inhalation of dirty air leads to the development of asthma, reduced immunity, respiratory failure, silicosis.

There is not only the high content of CO, but also the suspended solid particles PM 2.5in the urban environment.

What are PM2.5 particles? These are small pieces of asphalt, soot and car tires, particles of mineral salts, heavy metals.

Such dust is dangerous in that it does not cause the disease immediately, but accumulates, forming a chronic effect on the human body.

The particles are very light and go deep into the lungs, in the alveoli, as well as to the blood system, causing damage to the cardiovascular system.

Silicosis is a form of pneumoconiosis that develops when fibrogenic dust containing crystalline silicon dioxide (silica) is inhaled and deposited in the lungs. Silicosis was most widespread at the end of the 19th - the first half of the 20th centuries. in connection with the rapid development of the mining industry, machine tool and mechanical engineering, where workers were exposed to dust containing free silicon dioxide. Today, the disease is a thing of the past, although employment in certain industries is still associated with an increased risk of silicosis. Massive pulmonary fibrosis develops as a result of silicosis, which may progress even after exposure to dust has ceased.

The main source of particles is road transport (internal combustion engines), mining, industrial enterprises. There are problems of solid municipal waste management in the republic of Crimea [2].

The concentration of PM2.5 is the main parameter for assessing air quality and its impact on humans. According to WHO standards, the average annual level of PM2.5 should not exceed 10 μ g/m3, and the average daily level should not exceed 25 μ g/m3.

Based on 2022 data Sevastopol is included in the rating of cities in terms of air pollution (diagr.1).



Diagram 1 - Emissions of harmful substances per unit area, t/sq. Km

We carried out measurements in Sevastopol using a CEMDT-9881 gas analyzer. In the course of the study, about 20 measurements were made and it was found that at all points the average daily MPC was almost 3 times higher than the norm.

This means that to solve this problem, one need to reduce the amount in the city, or install air purifiers.

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FORMATION OF A MECHANISM FOR QUALIMETRIC ASSESSMENT OF THE QUALITY LEVEL OF ENVIRONMENTAL INDICATORS OF PRODUCTS

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Аннотация. Квалиметрическая оценка качества направлена на получение количественных значений показателей качества. Формирование механизма квалиметрической оценки уровня качества экологических показателей продукции проводится через определение значений единичных, групповых, комплексных и интегрального показателей качества продукции. При формировании механизма квалиметрической оценки уровня качества экологических показателей продукции учитываются коэффициенты весомости. В статье разработан алгоритм формирования механизма квалиметрической оценки уровня качества экологических показателей продукции.

Ключевые слова: качество, квалиметрическая оценка, коэффициент весомости, показатель качества, уровень качества, экологические показатели

Annotation. Qualimetric quality assessment is aimed at obtaining quantitative values of quality indicators. The formation of a mechanism for the qualimetric assessment of the quality level of environmental indicators of products is carried out through the determination of the values of individual, group, complex and integral indicators of product quality. When forming a mechanism for the qualimetric assessment of the quality level of environmental indicators of products, weighting coefficients are taken into account. The article develops an algorithm for the formation of a mechanism for the qualimetric assessment of the quality level of environmental indicators of products, weighting coefficients are taken into account. The article develops an algorithm for the formation of a mechanism for the qualimetric assessment of the quality level of environmental indicators of products.

Keywords: quality, qualimetric assessment, weighting factor, quality indicator, quality level, environmental indicators.

Environmental quality indicators characterize one of the properties of the quality level of products as a whole.

The selected quality indicators for product characteristics should be: simple, informative, operational, accurate, sensitive, i.e. providing sufficient sensitivity to the effects of production factors, consistent, which means proportional dependence on the overall assessment of product quality, complete, covering all links and stages of production, usable and uncontroversial[1, 2].

Depending on the purpose, significance, sensitivity to the degree of satisfaction of needs, quality indicators can be divided into main and secondary. Currently, environmental indicators of the quality of production can be attributed to the main ones.

To identify environmental quality indicators, enterprises need to determine:

- harmful impurities released into the environment during the production;

- the probability of emission of harmful particles, gases and radiation.

The identified set of quality indicators should be structured in the form of a nomenclature of quality indicators. The nomenclature of quality indicators is an ordered list of indicators for certain properties, taking into account the hierarchy of indicators, i.e. individual, group, complex and integral quality indicators. The application of the nomenclature of quality indicators allows us to obtain results both on individual properties of environmental quality indicators and an aggregate assessment on group or complex quality indicators. The integrated assessment of environmental quality indicators reflects the ratio of the total effect of operation and the total costs of its creation, operation, without the influence of harmful factors. An integral environmental indicator of product quality should take into account the effectiveness of its use for a certain time.

The developed algorithm for the formation of a mechanism for the qualimetric assessment of the quality level of environmental indicators of products is shown in Figure 1.



Figure 1 – Algorithm for forming a mechanism for qualimetric assessment of the quality level of environmental indicators of products

It is necessary to determine the weighting coefficients and establish their significance in the qualimetric assessment of the quality level. The values of the weighting coefficients are determined using expert methods: the express method, the ranking method and the method of comparing quality indicators. The application of the above methods depends on the structure of the nomenclature of environmental quality indicators.

The use of weighting coefficients allows you to specify the weight of quality indicators and determine their significance in assessing quality.

The choice of the basic values of the indicators used to compare with the obtained values of the quality indicators of the evaluated products is of great importance in assessing the level of product quality. The basic values of environmental quality indicators are established in the regulatory and technical documentation.

In the qualimetric assessment of the quality level of environmental indicators, it is advisable to use an integrated method. It covers a set of individual indicators, group and complex quality indicators.

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UDC 614.8.027.2 INJURY PREVENTION IN ENERGY ENTERPRISES

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Аннотация. Статья посвящена рассмотрению вопросов предотвращения травматизма энергетических предприятиях. на Исследован комплекс мероприятий, проводимых в организации по сооблюдению требований охраны труда и безопасности. В заключении рассмотренырекомендации попрофилактике травматизма на производстве.

Ключевые слова: охрана труда, производство, травма, несчастный случай, предприятия энергетики, система управления охраной труда.

Annotation. The article is devoted to the issues of injury prevention at energy enterprises. A set of measures taken in the organization to ensure the requirements of labor protection and safety has been studied. In a conclusion the recommendations for the prevention of industrial injuries are considered.

Keywords: labor protection, enterprise, occupational injury, accident, labor protection management system.

Introdction. An urgent problem at any energy enterprise is the issue of ensuring the safe work of employees. To exclude industrial injuries, technical and organizational measures are being taken to ensure the protection of employees [3, 10].

The labor protection management system (LPMS) is the activity of structural divisions and functional services regulated by regulatory and organizational and methodological documents for the implementation of organizational, technical, sanitary and hygienic, sanitary and therapeutic and preventive measures aimed at ensuring human safety in the labor process [11].

An indispensable condition for the functioning of an integrated labor protection management system at an enterprise is the minimum required number of indicators that "characterizing labor protection and degree of management decisions implementation in production units and functional services" [8].

The main directions of work in the field of prevention of industrial injury are stated by V.G. Burlov, V.D. Mankov, M.A. Polyukhovich [1],A.S. Zilberman [3] and others. So, V. Matusevichstudied problems of electrical safety at energy enterprises [9].

The subjective of this article is consider the issues of injury prevention at energy enterprises and propose a set of measures taken in the organization to ensure the requirements of labor protection and safety has been studied

The main part.According to Occupational Health and Safety Management Systems Guidestandard, LPMS in the electric power industry includes following key principles:

1) "ensuring the safety and health of all members of the organization by

preventing work-related injuries and incidents" [8]. It is necessary to create ensuring the safety of workers, in order to exclude industrial injuries. Workers should be equipped with places for good rest. Various technical and organizational measures are formed to ensure the protection of personnel from the harmful and dangerous effects of electric current and electric arc.

2)"investigation of work-related injuries, illness and incidents and their impact on safety and health activities" [8]."Electrical injury compared to other types of occupational injuries is a relatively small percentage, however, in terms of the number of injuries with severe and especially fatal outcomes, it occupies one of the first places" [8], and at energy enterprises, accidents due to electric arc damage to personnel account for 70%. The human factor is everything that depends on a person, their desires, abilities, etc.

3)"conducting audits to determine whether the occupational health and safety management system and its elements are appropriate, adequate and effective for ensuring the safety and health of workers and preventing incidents" [8]. As analysis of the causes of injuries demonstrated, employees did not comply with specific aspects of professional requirements, job descriptions, rules.

4)"compliance with relevant laws and regulations on labor protection, voluntary programs, collective agreements on labor protection and other requirements that the power company has committed to comply with" [8]. Job descriptions violation for engineers, managers is 79% of cases and regulation violation on the labor protection management system equals 20% of cases.

5)"monitoring the implementation of measures aimed at preventing work-related injuries, ill health, and incidents" [8].In addition to the analysis of psychophysiological characteristics, when applying for a job, the stage of professional selection and selection is undeniable. At this stage, it is necessary to study the employee's readiness to perform professional tasks [8].

Preserving workers' life and healthis one of the main tasks, therefore. The policy in the field of labor protection should be designed taking into account the latest achievements in the organization of the labor protection management process[3, 8].

In almost every case, "employees did not comply with specific aspects ofjob descriptions, rules, professional requirements (pict. 1), for example: prohibition of unauthorized work and when inspecting electrical installations with voltages above 1000 V to enter premises, chambers that are not equipped with fences; admission to work only after checking the preparation of the workplace" [8].

International experience shows that risk indicators are used to make informed decisions in the field of ensuring the safety of the population, the state, and the environment. according to experienced workers, there is a formal (unreasonable) assignment to personnel performing work in existing electrical installations of higher electrical safety groups. This situation was allowed due to the viciously established practice of assigning groups to electrical personnel[2].



Picture 1 –Analysis of the causes of electrical injuries in the Russian Federation

Ensuring the required level of safety is directly related to achieving an acceptable level of risk [10]. In order to ensure the safe work of personnel at energy enterprises, regular monitoring and control of industrial injuries is carried out.Rationale of the acceptable level is carried out on the basis of risk analysis. For potentially hazardous production facilities in Russia, it is advisable to establish Maximum permissiblelevel (MPL) of an individual risk limit value in the range of 10"4-10"5 per year as a general federal standardaccordingly to to the criterion of novelty of an industrial facility and combined hazardous impact [8].

Thus, the analysis of accidents is one of the main methods for eliminating accidents at work. Only after identifying the true causes of an accident at work, it becomes possible to determine ways to eliminate its reoccurrence or reduce injuries. The analysis of occupational diseases and injuries at work is carried out in accordance with the information provided in the acts of investigation of accidents, occupational diseases, as well as sheets of temporary disability. The study of the causes of the occurrence of harmful production factors that contributed to the occurrence of an accident or occupational disease is carried out [7]. Based on the technical re-equipment, mechanization and automation of production, the introduction of new equipment and technology, the modernization of existing equipment, a wide range of measures is being taken to eliminate dangerous and harmful production factors in the workplace. It should be noted that at many enterprises, working conditions do not yet meet the requirements of modern rules and regulations, as a rule, occupational injuries and occupational diseases still remain at a high level.Therefore, in order to develop preventive measures to prevent injuries, a deep study of the causes of its occurrence is necessary [5].

The analysis of traumatism expands the circle of engineering, sanitaryhygienic, psycho-physiological and legal knowledge and allows you to look at the usual technological process from a new perspective, often revealing a certain pattern of manifestation of danger in it.

Industrial injuries are a very complex phenomenon. Hazardous production situations that give rise to accidents are formed under the influence of many factors. Each factor, in turn, can be a source of several causes that contribute to the emergence of hazardous conditions in the workplace to varying degrees. All these reasons are, as a rule, in mutual connection and conditionality. To identify all the acting factors and causes, to find their relationship, role and place in the process of forming a dangerous situation – this is the main task in the analysis of each specific accident [12].

Conclusion.In this regard, in order to prevent industrial injuries, primarily severe and fatal, the following should be organized:

- effective multi-stage production control along the entire vertical of management of an economic entity [3, 10, 11];

- improvement of the personnel training system on labor protection in terms of briefings, training and testing of knowledge of labor protection requirements, incl. using modern teaching aids, simulators, etc.;

- training and retraining of personnel using modern testing methods.

The implementation of these measures, combined with effective control, will prevent a significant proportion of serious and fatal accidents.

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LEVELS OF DEVELOPMENT OF ACCIDENTS AT REFUELING COMPLEXES

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Аннотация. Статья посвящена рассмотрению сценариев развития аварий на автозаправочных комплексах. Показаны группы типовых сценариев и уровни развития аварий на АЗС. Представлены возможные сценарии развития аварии на автозаправочном комплексе для АЗС
реализации сжиженных углеводородных газов. Раскрыты факторы пожарного рискапри эксплуатации АЗС.

Ключевые слова: автозаправочные комплексы, сценарий аварии, A3C реализации сжиженных углеводородных газов, пожарная безопасность.

Annotation. The article is devoted to the consideration of scenarios for the accidents at filling stations. Groups of typical scenarios and levels of its development are shown. Possible scenarios for the development of an accident at a filling stations for the sale of liquefied hydrocarbon gases are presented. The factors of fire risk during the operation of gas stations are disclosed.

Keywords: gas stations, accident scenario, filling stations for the sale of liquefied hydrocarbon gases, fire safety.

Introduction. Fire safety issues at filling stations (gas stations) are of priority [2]. Fire safety requirements at filling stations are described by the following regulatory documents:

-Set of rules156.13130.2014 Car filling stations. Fire safety requirements;

-Safety regulations 12 - 527 - 03 "Safety rules for the operation of automobile filling stations of liquefied gas";

- Fire safety standards 111-93 "Gas stations. Fire safety requirements»;

-Federal Law-116 "On industrial safety of hazardous production facilities.

The scenario of an accident at a gas station can be defined as a sequence of separate logically related events caused by an initiating event and leading to an accident with dangerous consequences [6].

V.G. Kovalenko, A.S. Safonov, A.I. Ushakov, V. Shergalns described filling stations, their equipment. Exploitation and safety [1]. S.A. Shevtsov, Ya.N. Gunko, A.C. Khazhnnchenko, I.A. Bykov analyzed fire hazard situations in storage tanks for light oil products [4].

The article is devoted to the consideration of scenarios for the development of accidents at filling stations.

The main part. When determining possible accident scenarios at gas stations, the following are used:

- statistical data;

- method of studying the danger and performance;

- methods of analysis.

Each accident can have several stages of development. With a combination of certain conditions, the accident can be suspended, it can move to the next stage of development or to a higher level [7].

The following groups of typical scenarios for the development of an accident at gas stations are distinguished:

- release of a hazardous substance without consequences - N;

- Strait fire W;
- fire-flash V;
- explosion of the fuel-air mixture (FA) T;
- fireball B.

One should consider possible scenarios for the development of an accident at a filling station for a station selling liquefied hydrocarbon gases (LHG) (Table 1).

The following levels of accident development are distinguished:

- level "A" – the accident is characterized by its development within the filling station or its territories, localization is possible by the personnel of the organization, and, if necessary, by professional emergency rescue teams;

- level "B" - the accident is characterized by its exit from the filling station or its territories and its development within the boundaries of the enterprise, localization is possible with the involvement of emergency rescue teams, fire and medical departments [5];

– level "B" – the accident is characterized by the development and exit of its damaging factors beyond the borders of the filling station, the elimination of accidents and their consequences, evacuation and rescue operations are carried out under the leadership of the municipal or regional commission for emergency situations with the involvement of the necessary enterprises and organizations [3].

S	Scenario description	Damaging
number		factor
1	2	3
N	Depressurization/destruction of equipment - Leakage of hazardous substance - Spillage - No source of ignition - Vaporization of hazardous substance - Dispersion of vapors without ignition - Contamination of the	Environmental pollution
	environment	
W	Depressurization/destruction of equipment - Spill formation - Ignition from an ignition source - Spill fire - Exposure to thermal radiation on people and equipment - Formation and spread of a cloud of combustion products, environmental pollution	Thermal radiation
V	Depressurization/destruction of equipment - Spillage/vapour release - No flash ignition - Delayed ignition - Cloud of combustion products formation -	Thermal radiation

Table 1. Scenarios (S) of the possible development of an accident for a filling station selling LHG

	Flash fire - Human exposure to thermal radiation	
Т	Depressurization/destruction of equipment - formation	Shock wave
	of a spillage / release of the vapor phase - no	
	instantaneous ignition - delayed ignition - formation of	
	a cloud of fuel assemblies - presence of an ignition	
	source - explosion of fuel assemblies - injury to people	
	by a shock wave, destruction of buildings, structures	
	and equipment	
В	volume entering from LHG to fire focus — heating the	Thermal
	contents to a temperature significantly higher than the	radiation
	normal boiling point, with a corresponding increase in	
	pressure — rupture of the tank with the formation of a	
	"fireball" — exposure to thermal radiation on people	
	and equipment	

Conclusion. Thus the article describedpossible scenarios for the development of an accident at a filling station for the sale of liquefied hydrocarbon gases. The factors of fire risk during the operation of gas stations are disclosed by the author. The compliance with fire safety rules allows gas stations to carry out their activities successfully.

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UDC 628.4.037113.01:658.567.1:629 DISPOSAL OF TIRES IN A TRANSPORT ENTERPRISE Vyacheslav Ley

Associate Professor of Technogenic Safety and Metrology Department SevastopolStateUniversity

Аннотация.Статья посвящена рассмотрению вариантов утилизации изношенных шин на транспортном предприятии. Раскрыто социально-экономическое значение рационального использования изношенных шин. Представлены задачи транспортного предприятия «КрымАвто» по разработке технологии переработки изношенных автомобильных шин с обеспечением безопасности труда оператора. Показаны различные технологии измельчения шин. В качестве наиболее «экологичного» варианта переработки автошин определена технология механического измельчения.

Ключеные слова: переработка шин, дезинтегратор, условия труда, механическое измельчение.

Annotation. The article is devoted to the options consideration for the disposal of used tires at a transport enterprise. The socio-economic significance of the rational use of worn tires is disclosed. The tasks of the transport enterprise "KrymAvto" on the development of a technology for the disposal of worn-out car tires are presented, taking into account the safety of the operator. Various tire shredding technologies are shown. As the most acceptable option for the processing of tires at a small enterprise, the technology of mechanical grinding is determined.

Keywords: tire recycling, disintegrator, working conditions, mechanical grinding.

Introduction. The products of uncontrolled combustion or burning of waste tires have a negative impact on the environment. Also, tires are secondary material resources and are subject to collection and use as secondary raw materials and cannot be transferred to a landfill for disposal.

«The combustion temperature of tires is equal to the combustion temperature of coal, harmful products, including carcinogens, are emitted

into the air" [2]. Tires pose a threat to ecosystems as they practically do not decompose. However, they can be recycled into valuable recyclable materials such as rubber, metal and textile cord [3].

The appropriate use of worn tires is of significant socio-economic importance. "The transport company "KrymAvto" (Simferopol) solves the problem of reducing the volume of waste and involving them in the resource cycle in order to reduce costs and form a respectful attitude towards the environment" [5]. The issues of development of recycling technologies are relevant nowadays [4, 6, 7].

The increase in the number of used tires every year has forced to develop a program in accordance with which the following tasks are solved:

- increase the share of retreaded tires up to 25-30%;
- reduce the estimated number of tires by 10%;
- increase the share of recycled tires with rubber crumb up to 60%;
- stop taking tires to landfills (pict. 1).



Picture 1. - The tasks of a program on used tires disposal (in %)

A centralized tire collection system has not yet been established. In the case of the introduction of a physical method of their processing (cutting) into chips, the technological process will be accompanied by "increased levels of harmful effects (mainly vibroacoustic and chemical)" [4, p. 160]. "When creating a technology for the disposal of production waste at the transport enterprise "KrymAvto", taking into account the requirements of labor safety, it is necessary to solve a number of problems" [9].

In Russia, tire recycling is a serious environmental and economic problem. Thus, according to the research institute of the tire industry, about 1 million tons of tires are put out of service every year in the country, and up to 60 thousand tons of worn tires are formed every year in Moscow alone.

Worn tires are formed in industrial enterprises, car service enterprises, as well as in the private sector. Many countries have programs to support recycling of used tires. In most cases, the very fact of recycling car tires is paid at the rate of 50 - 400 EUR per ton.

One should consider results of the "analysis of existing tire recycling methods and the choice of an option acceptable for implementation" [9]. Many waste tires are taken to landfills. Tires pollute the environment for a long time due to their high resistance to external factors.

Recycling used tires is an intractable technical problem, which is further complicated by steel cord application, which is used for truck tires. The rubber composition of car tires is presented in table 1.

ruble 1. The fubber composition				
Rubber composition	Material			
Rubber	natural or synthetic			
Cord fabric	Polymeric, textile or metal threads			
	(metal cord)			

Table 1. Tire rubber composition

Car tires can be recycled in a variety of ways. resources with maximum efficiency. "A tire is comparable to high-quality coal: its calorific value is about 30 MJ/kg" [9]. One of the simplest is incineration. Cost-effective tire recycling can solve environmental problems.

The problem of recycling worn-out car tires and out-of-service rubber products is of great environmental and economic importance for all developed countries of the world, and the irreplaceability of natural oil raw materials dictates the need to use secondary [7].

"On the other hand, burning tires is accompanied by the formation of toxic substances, and the organization of an adequate cleaning system requires significant investment" [7].

A method of pyrolysis is carried out in an environment with a lack of oxygen, "in a hydrogen atmosphere in the presence of catalysts and without them, in batch and continuous reactors, in a fluidized bed at various temperatures". However, the organization of pyrolysis production "significant resources and energy, which is not always advisable in a small enterprise" [1].Experts believe that the problem of pyrolysis of old tires is practically exhausted due to high costs and low quality of the products obtained.

It seems promising tire shredding technology at moderate cutting speeds, presented in table 2.

Operation	Used equipment		
Washing			
Side cutting	Bead cutter		
Pre-crushing	Circular knives, mechanical shears,		

Table 2. Tire shredding operations.

coarse crushing	Crushing rollers, tire cutter		
fine crushing	Impact crushers		
Separation	Separator for extracting metal		
	particles, Vibrating screen		
Grinding	Grinding rollers		

Used tire crushing technologies are being developed by domestic and foreign manufacturers. For example, the Cumberland company (Germany) [8] "produces high-performance plants for recycling used tires" [9].

One ton of tires contains 130-150 kg of textiles, 600-650 kg of rubber, 130-200 kg of metal. A used tire is a valuable secondary raw material containing 65-70% rubber (rubber), 15-25% carbon black, 10-15% high-quality material.

Thus, tire has a high fire hazard, and the products of their uncontrolled combustion have a harmful effect on the environment, as even a short list of products formed during tire burning and released into the atmosphere is impressive: biphenyl, anthracene, fluoranthene, pyrene - the list goes on. The most acceptable option for recycling tires at a small enterprise is the technology of mechanical grinding. Cost-effective tire recycling ensure high profitability of processing industries.

The article presented socio-economic significance of the rational use of worn tires. The tasks of the transport enterprise "KrymAvto" on the development of a technology for the disposal of worn-out car tires are stated, taking into account the safety of the operator. Various tire shredding technologies were shown and the technology of mechanical grinding was determined as the most acceptable option for the processing of tires at a small enterprise.

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THE IMPACT OF THE NAVY ON THE ENVIRONMENT: PROBLEMS AND SOLUTIONS

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Аннотация. Статья посвящена одной из глобальных проблем современности, с которой столкнулось человечество, – экологической проблеме. Автор подробно анализирует проблему влияния военноморского флота на окружающую среду, а именно: влияние надводных кораблей и подводных лодок, береговых войск на окружающую среду; выявление вредных факторов, вызванных работой инфраструктуры, обеспечивающей жизнедеятельность флота. В статье представлены возможные решения обозначенной проблемы по снижению вреда природе.

Ключевые слова: окружающая среда, военно-морской флот, решение экологической проблемы.

Annotation. The article is dedicated to one of the global problems of modernity which humanity has faced – the environmental problem. The author analyzes in detail the problem of the influence of the Navy on the environment, namely: the influence of surface ships and submarines, coastal troops on the environment; identification of harmful factors caused by infrastructure operation which ensures the vital activity of the fleet. The article presents possible solutions to the designated problem on reducing harm to nature.

Keywords: environment, Navy, environmental problem solution.

Introduction. The relevance of the environmental problem as one of the most serious problems of up-to-dateness is dictated by the need to take care of the environment since it is an integral part of human life, animal and plant life: without it nothing living can exist. Pollution of the soil, water environment, atmosphere, noise and light pollution – all this cannot but cause a state of concern and anxiety for the planet future. It should be recognized that the Navy whose main force is surface ships and submarines contributes to environmental pollution. The search for ways and means to reduce the harm to nature, so long as it does not endanger the existence of all life on the Earth, is the primary task facing the entire human community.

Attempts to correct the situation or at least minimize the harm that human activity causes to the oceans are being made by many scientists and organizations. Thus, at the initiative of the UN, many important international agreements regulating the use of the World Ocean's resources were signed. The most famous was the UN Convention on the Law of the Sea, signed in 1982 by most countries. There are also various world and regional conventions: The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Materials (1972), the International Convention on the Establishment of an International Fund for Compensation for Damage from Oil Pollution (1971 and 1974), the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Harmful Substances by Sea (1996) and others. Such close attention to the ecological problems of seas once again underlines the special importance of the marine ecosystem for the world civilization as a whole.

The purpose of this article is to analyze the problem of the Navy's impact on the environment, namely: the impact of surface ships and submarines, coastal troops on the environment; identification of harmful factors caused by the operation of the infrastructure which ensures the vital activity of the fleet; as well as an attempt to identify possible solutions to the designated problem of reducing harm to the nature.

The research methodological basis is the works of Russian authors (Yu. A. Galysheva [1], S. Neshiba [2], S. A. Patin [3], K. M. Petrov,

A.A. Bobkov [4], V. P. Voloshin [5], M. B. Shilin, O.V. Khaimin [6]) dedicated to the problems of marine ecology and the search for the most effective ways to save both the ecosystem of the seas and oceans, and the environment as a whole.Thus, V. P. Voloshin's monograph [5] summarizes and systematizes information on marine environmental protection issues related to the operation of marine transport and offshore drilling rigs for oil and gas production; measures aimed at reducing marine pollution are considered, attention is paid to legal issues of marine environmental protection.Yu. A. Galysheva [5] examines the problems of environmental factors influence on marine organisms, the main abiotic factors and the impact on the quality of the marine environment by humans, and reveals the main patterns of marine biota response to habitat change as well. The work of S. A. Patin [3] presents an analysis of environmental problems associated with oil spills in the sea and their consequences for the marine environment, bioresources and fisheries.

Recent developments in the field of modern oceans, seas and their coastal zones research provide valuable information for assessing achievements in the study of such problems as: the problem of marine ecosystems ecology (A. Borja, J. H. Andersen, C. D. Arvanitidis, A. Basset [7]), the problem of noise pollution impact on marine ecosystems (L. Prosnier [8]), the problem of hypoxia in coastal seas which poses a serious threat to marine ecosystems, in particular to the ecosystem of the Baltic Sea (S. Piehl, R. Friedland, B. Heyden, W. Leujak, T. Neumann, G. Schernewski [9]), the problem of using engineered nanoparticles to remove carbon dioxide from the atmosphere by increasing the population of phytoplankton in the oceans which, according to the authors, is affordable, viable and safe for marine ecosystems (P. Babakhani, M. Hochella [10]).

In the process of writing this article, the following **research methods** were used: analysis of scientific sources on the research topic and synthesis of various concepts into a single system, comparison of research results, generalization of common factors affecting the environment.

Problem analysis. First of all, consider the impact of surface ships and submarines on the environment. The fact that their activity leads to harm to nature is irrefutable. To begin with, they emit a large amount of waste into the air which leads not only to atmospheric pollution, but is also one of the main causes of the so-called greenhouse effect the essence of which is that the ozone layer is destroyed which, in its turn, affects the increase in the amount of ultraviolet radiation entering the Earth, and as an inevitable result – global warming. Ozone holes and warming have caused icebergs to melt and sea level rise which poses a threat of flooding many coastal cities. Global warming threatens humanity with the fact that as a result of temperature changes the Earth will become uninhabitable.

There is also a problem of fuel spillage on the water which leads to pollution of reservoirs and the extinction of various species of animals and plants. Moreover, there is a problem of various wastes release into the aquatic environment which appear during troubleshooting and operation while the ship is at sea and performs assigned tasks. The use of weapons causes irreparable harm to the environment which is also an irrefutable fact. It should be added to this that radar stations and propellers also harm nature with their work. They produce vibrations that harm the animal world which is proved by numerous studies.

Another problem is related to the impact of coastal troops on the environment since coastal troops are an integral part of the navy. Speaking about their impact on the environment, it should be noted that in order to carry out their combat missions, weapons are used which cause irreparable damage to nature. What is more, some tasks involve the use of illumination machines that are equipped with large lanterns which causes severe light pollution, which greatly harms the animal world. The problem is that radio stations are constantly being used which can cause headaches in humans and can even cause panic and rabies in animals. In addition, in the process of vital activity, as well as when performing tasks, a large amount of garbage is thrown out which harms the soil. And finally, the use of large amounts of electricity and fresh water also causes irreparable damage to soil and reservoirs.

It is necessary to note the influence of harmful factors caused by the operation of the infrastructure which ensures the vital activity of the fleet as well. Speaking about the problem of the Navy's influence on the environment, do not forget about the enterprises which ensure the vital activity of the fleet. Such enterprises include:

- docks;
- ship repair plants;
- shipbuilding plants;
- enterprises for the disposal of nuclear engines and fuel.

Factories emit production waste into the atmosphere and reservoirs which leads to irreparable consequences and great harm to the environment in those areas where factories are located, as well as where raw materials are taken for their operation. Such enterprises use a huge amount of electricity, the production of which requires a large number of different types of fuel. Moreover, there are various areas created for the disposal of nuclear engines and radioactive waste. Separate places and districts are allocated for these purposes, but fuel and engines are disposed by conventional canning at recycling plants. Canning does not help properly, and the environment constantly receives a large dose of radiation which leads to the extinction of plant and animal species in the area, poisoning the environment. Based on the above facts, we can say that the vital activity of the Navy is harmful to the environment. It is worth admitting that it is impossible to avoid harm to nature, but we are ready to offer possible solutions to the above problems to reduce harm to nature.

First of all, we are talking about the development and installation of filters on any pipes that will reduce the amount of exhaust gases which will immediately reduce the rate of the ozone layer destruction, and therefore reduce the risk of irreparable consequences of global warming. Speaking of filters, it is worth noting that we keep in mind not only the pipes of factories which function for the needs of the fleet, but also pipes installed on ships.

It is necessary to create a competent commission which will monitor the amount of gases emitted into the atmosphere and be responsible for ensuring timely repair and replacement of filters. In addition, it is necessary to develop new methods of eliminating the consequences of oil spills, involving not only the collection of fuel, but also the restoration of the spill area environment.

As for the coastal troops, it should adhere to the three R's rule (according to the Latin alphabet): Reduce, Reuse and Recycle.

It is necessary to reduce the consumption of electricity and water as much as possible provided that all complexes operate normally and maintain vital activity at a sufficient level.

It is necessary to use various materials that can be recycled and reused.

It is necessary to consider the possibility of replacing internal combustion engines in the used equipment with electric ones because they are much less harmful in environmental terms.

Finally, it is necessary to pay attention to the disposal of nuclear engines and nuclear fuel waste. The creation of new alloys which do not transmit radiation and do not allow environmental pollution is one of the ways to protect the environment.

Conclusion. Based on the analysis of the problem of Navy's influence on the environment, the following conclusions can be drawn:

1.Not all the harm caused by the fleet we can exclude: first of all, it is the harm associated with the use of weapons.

2.However, in cases where we can protect the environment at least a little, we must do all our best and possible because not only the well-being of ecosystems depends on the state of the environment – human civilization itself largely depends on the environment: air, water, soil. The sea is a unique object of nature in which the ocean, land and atmosphere interact, not excluding the influence of anthropogenic factors. A special natural zone is being formed on the sea coasts which has an impact on the ecosystems located nearby. The waters of rivers flowing through various settlements flow into the seas and feed them.

3. The above solutions to the problems are just a small list of what can be done to preserve the environment in order to prevent an ecological catastrophe. It is important to understand in time that the environmental problem is one of the most important modern problems that humanity faces and the solution of which requires joint efforts of different spheres of life representatives, and even different countries.

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UDC 574.5(285.32) SPECIES DIVERSITY IN THE EXTREME BIOTOPES OF HYPERSALINE WATERS

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Аннотация. Гипероленые озера или рассолы (более 40 г/л) являются уникальными экосистемами с уникальным экстремофилным биоразнообразием. Поскольку биоразнообразие снижается по мере увеличения солености, гиперсоленые озера и лагуны являются экосистемами с относительно низким разнообразием, с простыми следовательно, считаются подходящими пищевыми сетками И, лабораториями естественными для решения фундаментальных вопросов биологии. Данный обзор суммирует современные научные данные по вопросам выживания и репродуцирования обитающей в таких экстремальных условиях биоты.

Ключевые слова: гиперсоленые озера, экстремальные местообитания, микро- и макроорганизмы, водоплавающие птицы, биоразнообразие.

Annotation. Hypersaline lakes belong to one of the most extreme habitats of our planet and are found on all continents, most of them located in arid and subarid zones, where high evaporation rates exceed rainfall. Since biodiversity declines as salinity increases, hypersaline lagoons are relatively low-diversity ecosystems with simple food webs and hence are considered suitable natural laboratories to address fundamental questions of biology. As a result, the studying of such highly diverse communities with their specific trophic interactions is of great interest in light of the investigation of key ecosystems in the world. The main goal of this review is to explore the current understanding of the ecological dynamics of hypersaline ecosystems by addressing one of the main research questions concerning biota inhabiting these ecosystems and their adaptation to the high salt conditions.

Keywords: hypersaline lakes, extreme habitats, micro- and macroorganisms, waterbirds, biodiversity.

1. Introduction

Hypersaline lakes – water bodies with the concentration of salt exceeding the value of 35 g/l. They host some of the most unique communities on the planet and therefore valuable from the point of view of ecology. They are the ecosystems with high salinities, high daily variability of abiotic factors including dissolved oxygen levels, and "high freezing points. These peculiarities intrinsic to 'polyextreme ecosystems' distinguish them from their freshwater counterparts" [16, p. 418]. "Though innumerable impacts (e.g. sewage effluents, runoff pollution, etc.) constantly affect the hypersaline lakes they are very technologically promising due to high concentration in key elements such as lithium together with uncontrolled extraction of silts, gravel and mud" [11, p. 1904]. These lakes are suffering not only from reduced water levels but also from climate change impacts leading to unpredictable rainfall events connected with increased droughts, droughts, breaking the delicate ecological balance sustaining these environments.

Recent microbiological studies on the community patterns of hypersaline lakes have shed new light on their microbial metabolic adaptations in such 'extreme' environments. Many hypersaline lakes are known to provide Mars-like conditions (e.g. flowing water in the form of brine, low water activity, evaporate minerals entrapping and "protecting fluid), thereby creating conditions of studing the past and future of life on Earth and beyond" [13, p.2]. Moreover, "hypersaline macroinvertebrate communities (usually dominated by brine shrimp Artemia spp. at salinity levels >120 g/l) maintain populations of amphibians, reptiles and associated terrestrial taxa, and an extensive diversity of waterbird species depend on these habitats for feeding and breeding" [18, p.10].

The green unicellular microalgae D. salina synthesizes β -carotene is widely used in industry, animal husbandry and medicine. The cyanobacterium Nostoc cf. linckiaBornet ex Bornet et Flahault, 1886, which also lives in hypersalted lakes of Crimea, can produce nostococarboline, on the basis of which new drugs for the treatment of Alzheimer's and Parkinson's diseases can be created [17, p. 25].

In recent years, interest in the study of species diversity in these extreme biotopes has been growing, primarily in bacteria and archaea. However, our current understanding of the bio-geochemical mechanisms sustaining hypersaline biotas is far from complete, raising a compelling need to incorporate multiple disciplines into holistic research designs. [19].

The main goal of this review is to focus on the diversity depiction and functional aspects of key taxa found in hypersaline lakes from microorganisms to plants, invertebrates, waterbirds and upper trophic levels. Apparently, the existing information is incomplete and more detailed future studies are required for a complete inventory of the biodiversity of these extreme environments, which are the important sources of unique biological and functional diversity.

Hypersaline biota of hypersaline lakes includes: 1) "Microbes and viruses; 2) Algae and plants; 3) Aquatic invertebrates; 4) Aquatic vertebrates and other animals" [15, p.8].

Hypersaline lakes are considered as global hotspots of microorganism diversity and the groups of archaea, bacteria, fungi, protozoa and viruses play an essential role in regulating biogeochemical cycles under high salt concentrations.

2. Microbes and viruses

a) Archaea

Archaea of the class Halobacteria within the phylum Euryarchaeota form a phylogenetically coherent group that consists only of halophiles. The class is currently divided into three orders (Halobacteriales, Haloferacales and Natrialbales) and six families (Halobacteriaceae, Haloarculaceae, Halococcaceae, Haloferacaceae, Halorubraceae, and Natrialbaceae). For growth and structural stability they require over 100–150 g/l of salt while exposing to salinities they dissolute.

Halobacteria live on simple organic carbon sources and belong to the aerobic heterotrophs. However, as show the researches of the metabolic abilities of the members of this group, they are characterized by a considerable diversity in their nutritional demands, range of degraded carbon sources and metabolic pathways. Their photoheterotrophic lifestyle is confirmed by ability to grow by anaerobic respiration or by fermentation. Also it is believed that "members of halobacteria for bioenergetic processes use arsenic compounds" [10, p.3].

Recently, a new group of small halophilic Archaea was discovered. This large group of Nanohaloarchaeota is widespread in hypersaline environments but has not been grown successfully in an axenic culture. It probably may be explained by its dependence on the presence of other archaea for growth. "Candidatus Nanohaloarchaeumantarcticus" (sic) can be grown together with Halorubrumlacusprofundi. It was found in an Antarctic hypersaline lake and can expand the range of substrates available for its host, a chitinotrophicHalomicrobium sp. from a saltern crystallizer pond [8].

(b) Bacteria

A diverse group of bacterial species inhabit hypersaline lakes worldwide. Halophiles have been documented in the phyla Proteobacteria, Cyanobacteria, Rhodothermaeota, Firmicutes, Actinobacteria, Bacteroidetes and Spirochaetes, and probably compose additional bacterial lineages. Halophiles are generally found close to non-halophilic relatives in the phylogenetic tree, and there are only "a few phylogenetically coherent groups that consist exclusively of halophilic or highly halotolerant members" [12, p.4]. One specialised group of moderately halophilic aerobic heterotrophs is the family Halomonadaceae (class Gammaproteobacteria), members of which can adapt to a wide range of salinities. Halomonaselongate was first isolated from a marine saltern pond. Due to such features as maintaining low intracellular ionic concentration and usage of organic solutes for regulating the osmotic pressure inside its cells "it has become a model organism for the study of the adaptation of bacteria to changing salinities" [11, p.112].

An interesting extremely halophilic member of the Bacteria is Salinibacter, was found to be an important contributor to the prokaryotic communities in natural salt lakes and salterns worldwide. It is pigmented red by carotenoids and similar to the extremely halophilic Archaea of the Halobacteria class. Thus, it requires at least 100–150 g/l salt, uses inorganic ions to provide osmotic balance and possesses retinal proteins "that may enable its cells to use light as an energy source" [6, p. 2].

(c) Fungi

The truly halophilic fungi in solar salterns was discovered only about 20 years ago. Since that time y of truly halophilic fungi in solar salterns Debaryomyceshansenii, species like Hortaeawerneckii. and Wallemiaichthyophagahave been isolated globally from natural hypersaline environments. They include both ascomycete and basidiomycete fungi. Melanised fungi, represented by black, yeast-like hyphomycetes including Hortaeawerneckii, Phaeothecatriangularis, Trimmatostromasalinum, and Aureobasidium pullulans, and phylogenetically closely related Cladosporium species have been isolated from hypersaline waters on different continents [3, 9]. Adaptation to high salt and low water activity was investigated in depth in H. werneckii, which is able to grow in conditions of NaCl near-saturation. Under hyperosmotic stress, "energy generation is increased to drive export of ions and synthesis of organic osmotic solutes. In addition, changes in the lipid composition of the cell membrane and the cell wall ensure the integrity and functioning of the stressed cells" [2, p. 85].

(d) Viruses

Viruses are found in higher numbers (up to 1010 virus-like particles per ml) in hypersaline ecosystems than in other aquatic environments. The discovery of the first viruses happened in the early 1980s. and to date more than 100 viruses have been described from hypersaline ecosystems. Most of

them belong to the class Halobacteria. As shown in the course of electron and epifluorescence microscopy research in salt lakes the numbers of virus-like particles exceed "the number of prokaryotic cells by at least an order of magnitude" [5, p.48]. A wide variety of viruses, including tailed and non-tailed morphotypes is determined by their global survey in salt lakes and other hypersaline environments

(e) Protozoa

High-salinity waters from salterns, salt lakes and deep hypersaline anoxic basins contain diverse halophilic protozoan assemblages despite the fact that protozoa do not play a great role in the regulation of community densities of prokaryotes and other eukaryotes at salinities exceeding 200 g/l. Species of Heterolobosea, Bicosoecida, and Ciliophora are some of the most studied and can be classified as extreme or borderline extreme halophiles. Another wellstudied taxon is Colpodella spp., highly abundant (reaching up to 20×107 cells/m3) "even in salt-saturated conditions, such as at Lake Tyrell (Australia), where salinity can exceed concentrations of 300 g/l" [14, p. 110].

Hypersaline water bodies are often characterised by extremely high primary productivity. For instance, the level of primary production (PP) observed in Crimean hypersaline waters ranges from 4 to 14 g C/m2 day for phytoplankton, "with PP of the filamentous green algal Cladophora mats reaching even higher values – from 3 to 46 g C/m2 day, and PP of algobacterial bottom films recording values up to 4.3 g C/m2 day" [21, p.1933]. The hypersaline planktonic species (green unicellular algae Dunaliellasalina and D. parva are often found over a wide salt range from 9 to 250 g/l.

It should be mentioned that, as show eco-physiological experiments, Dunaliella growth optima are lower (up to 90–150 g/l) than the salinity range of their occurrence in nature. This experimental fact can be explained by relaxation of trophic pressures, resulting in a wide spectrum of abundances of Dunaliella across hypersaline waters in different areas, e.g. up to more than 50×107 cells/m3 in Crimean saline lakes [20, p.23].

At the same time primary production in brine waters is not only characterised by monospecific populations, which are observed in Great Salt Lake and in the hypersaline lakes of the Crimean region. Great Salt Lake in the Nearctic ecozone hosts rich phytoplanktonic communities, including green algae (Dunaliellaviridis, D. salina, Carteria sp., Oocystis sp., Treubariatriappendiculata, Sphaerellopsis sp., Spermatozopsis sp.). dinophytes (Glenodinium sp.) and "a large number of diatom species and (Nodularia Coleofasciculuschthonoplastes, cyanobacteria spp., Pseudanabaena spp. and Spirulina spp.)" [1, p.12]. Crimean hypersaline lakes - with salinity ranges varying from 35 to 400 g/l - host more than 110 species of Cyanobacteria, more than a hundred microalgal species (mostly diatoms),

and seven species of filamentous green algae (mostly Cladophora spp.). Other diverse phytoplanktonic communities are found in Dead Sea, Kati Thanda-Lake Eyre, Salar de Atacama and in South Korean salterns amongst others.

4. Aquatic invertebrates

When the concentration of salinity is higher than 120-160 g/l, it is considered to be the main ecological driver, while at salinity levels up to this value biotic relations determine the structure of the food webs.

As illustrated in animal total species richness is expected to decline when salinity increases above 35 g/l. The compilation of all the ecological information available on hypersaline aquatic invertebrate communities (table 1) revealed that the total number of freeliving phyla is little affected by salinity levels of up to 100 g/l. The information was extracted from 167 obtained manuscripts which were through Google Scholar (https://scholar.google.com.au) by searching the kev terms "hypersaline/hyperhaline" + "taxa names" (i.e. Crustacea, Copepoda, etc.).

Salinity	Phylum	Class	Order	Genus	Species
range (g/l)					
35-50	12	25	83	455	809
51-70	11	22	76	358	606
71-100	11	18	55	259	427
101-130	7	13	31	123	215
131-160	7	13	24	80	126
161-190	6	11	20	54	85
191-220	5	9	16	46	69
221-250	4	7	12	36	51
251-280	4	7	10	22	31
281-310	3	6	9	16	25
310	1	4	5	5	9

Table 1. The number of aquatic invertebrate taxa found in hypersaline water bodies of the world in the salinity range 35 g/l to more than 310 g/l.

Despite the reduced species richness relative to freshwater systems, taxa able to adapt to life in brine can be extremely abundant (e.g. Artemia), reflecting a combination of reduced competition and extremely high productivity.

As a result, the total invertebrate biomass can exceed 100 g/m2, with densities of more than 106 individuals (ind.)/m3 for plankton, 5×105 ind./m2 in benthos, and 2×107 ind./m2 in species associated with floating mats. The maximum abundance for different invertebrate species is observed at salinities ranging from 50 to 220 g/l. Within this range, as salinity increases, the proportion of benthic animals declines and that of planktonic species

increases. It can be explained by switching benthic invertebrates (e.g. Harpacticoida, Ostracoda, Chironmidae larvae, etc.) at salinities >50-70 g/l to a planktonic lifestyle. At the same time, on the contrary, some meiobenthic species less than 2 mm in size may grow with salinity increasing.

5. Aquatic vertebrates and other animals that depend on hypersaline lakes

At the same time, each year hundreds of salt-encrusted waterbirds die from sodium poisoning. This was puzzling because natural history information shows that this species resides in saline and hypersaline environments for most of the year. The mortality of the salt-encrusted waterbirds can be attributed to complications of salt encrustation, notably impaired thermoregulation.

The elevated biological productivity of hypersaline lakes is supported by the large congregations of waterbirds in such systems. The dominance of these taxa in saline bodies is determined by their feeding on arthropods for all of the year. Apart from macroinvertebrates, birds can also consume microalgae (diatoms, cyanobacteria), detritus, aquatic plants and macroalgae in hypersaline habitats [4].

Hypersaline ecosystems are also a harbours of terrestrial predatory vertebrates, including reptiles, corvids, gulls and birds of prey such as falcons, vultures and eagles, and terrestrial mammals including foxes, coyotes, hyenas, and pumas. Amphibian and reptile communities might be faced with a possible threat of extinction due to unsuitable ecological conditions.

6. Conclusion

Hypersaline wetlands support an extensive number of taxa, ranging from microorganisms to migratory waterbirds, many of which are endemic and uniquely adapted to the poly-extreme conditions to which they are exposed. These systems have shaped the evolution of whole communities characterised by highly specialised metabolic and functional mechanisms that have allowed species to thrive and radiate despite the extreme conditions. However, the biological functioning of hypersaline lakes is being increasingly exposed to multi-layer pressures that are posing a risk to already fragile and endangered species. Understanding and modelling the extent of climatic and anthropogenic perturbations on these threatened ecosystems is pivotal, and the future of life under high-salt conditions will depend on how quickly we understand not just what lives in these systems, but how they function.

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LEADED GASOLINE AS ENVIRONMENTAL CONCERNS

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2nd year student, Design and Technological Support of Machine-Building IndustriesDepartment Sevastopol State University Scientific advisor, **Alla Mikhaylova** senior lecturer, Foreign Languages Department Sevastopol State University Аннотация. В данной статье рассматривается история развития технологий использования двигателя внутреннего сгорания (ДВС) в США с начала 50-х годов прошлого столетия. Результатом статьи является характеристика отрицательного воздействия на окружающую среду свинцовой присадки для топлива, используемого в ДВС.

Ключевые слова: свинец, экология, здоровье, CFC, гонки.

Annotation. This article discusses the history of the development of technologies for the use of an internal combustion engine (ICE) in the United States since the beginning of the 50s of the last century. The result of the article is a characterization of the negative environmental impact of a lead additive for fuel used in internal combustion engines.

Keywords: lead, ecology, health, CFC, racing.

Environmental concerns and conflicts have surfaced throughout human history, from the earliest settlements to the latest headlines [1, 5]. It has been 100 years since that pivotal day in the development of leaded gasoline.Currently, lead mostly disappeared from our lives quickly. It is, however, still allowed in motor racing and aviation at 0.05 grams per gallon.The purpose of the article is to discuss the history of the development of technologies for the use of an internal combustion engine (ICE) in the United States since the beginning of the 50s of the last century.

The story behind lead in gasoline is interesting. It has all the elements of a good environmental crime story about the fact how a profit-seeking company trying to hide the negative health consequences [3, 6]. Bill Kovarik admitted that" the hazards of lead were well known – even Charles Dickens and Benjamin Franklin had written about the dangers of lead poisoning" [4, www]. He wrote about the terrifying effects of lead poisoning on London workers who could find no other employment [2, p.28]. An engineer, Thomas Midgley, who worked at General Motors, created CFC (chlorinated

fluorocarbon), as well figured out that Tetraethyl lead could be added to gasoline, which prevented "knocking" in internal combustion engines."Both substances were cheap and became ubiquitous quickly" [2, p. 29]. GM and Standard Oil started a company called "Ethyl Gasoline



Corporation", which held the patent on the fuel additive.

Lead was a powerful neurotoxin – a substance that alters the function of thenervous system. More than 1,000 chemicals are stated to have neurotoxic effects. The substances compride a wide range both human-made and natural chemicalcompounds. Scientists had tested lead as a possible nerve

agent during the First World War. On theirmind, widespread lead poisoning was almost certainly to result. Young and elderly persons are known to be vulnerableto neurotoxic chemicals.

The companies had a profit from Tetraethyl lead, but it had the negative consequences. "The company claimed that the additive was safe" [4, www]. It became clear that leaded gasoline ran into trouble when the catalytic converter arrived. It would not function with leaded gasoline.

The 1970 Clean Air Act required significant improvements in air quality. The transportation sector was a major purpose. "Catalytic converters had to become part of the solution and that meant the end for leaded gasoline in personal cars. An epic battle between the EPA and the corporations behind Ethyl ensued"[4, www]. The EPA has implemented "standards designed to decrease the content of lead in gasoline from 1.1 grams per gallon in 1983 to 0.1 grams per gallon in 1986 and finally an almost complete ban in 1996"[4, www] (fig. 1).



Figure 1-Lead content in leaded gasoline

The leaded gasoline phase-out has been one of the most effective and at the same time understudied aspects of the Clean Air Act. Scientists have proved that racing organizations, the National Association for Stock Car Auto Racing (NASCAR) and the Automobile Racing Club of America (ARCA), switched from leaded to unleaded gasoline in 2007. One three- hour race emits much more lead than the annual emissions of the average airport during year.

They applied a "difference-in-differences design (which essentially compares changes in a number of outcome variables before and after the phase-out in communities with and without races) to show the impact of lead emissions on ambient concentrations, accumulation in the blood and impacts on mortality"[4, www]. They demonstrated credible causal effects of lead on these outcomes.

Races with leaded gasoline have resulted to higher environing lead levels, higher elderly mortality and concentrations of lead in the blood of children. "This is the first causal evidence of this link, which is amazing given that there has essentially not been any lead in your gas since the late 1980s"[4, www]. It was estimated "that the reduction in annual lead emissions from deleading NASCAR and ARCA races yielded social benefits of \$1,800 per child near these through avoided IQ reductions and \$2.2 billion per year from avoided premature elderly mortality" [2, p. 30].

The lead emitted from NASCAR races does more damage regarding to their mortality estimates in a year than the value of all teams combined.

The cost of a gram of lead in gasoline in their setting is stated to be \$1100. In terms of consumption 250 million gallons per day in 1980s and as regards the fact that each gallon contained 0.5 grams it is equalto billion dollars a year in the cost of emitted lead. Today, the public health argument for the elimination of leaded gasoline is widely accepted on an international level7,8.

Leaded gasoline was the subject of a federal inquiry. The Public Health Service concluded in 1926 that the dilute additive in gasoline posed no immediate threat to people. Nearly all gasoline contained lead within a few years.

Lead as a Well-known Cause of Occupational Disease

Scientists stated involved a case of severe lead poisoning and violent insanity among Standard Oil workers in a special section of the plant— the section where they made leaded gasoline [7].

Lead poisoning is one of the most frequently observed causes of occupational disease. From Roman antiquity through the industrial revolution, the cumulative effects of lead had become well known through painful experience. Roman engineer Vitruvius noted that lead fumes "rob the limbs of the virtues of the blood." [2, p.23].

Despite the historical knowledge of lead's dangers, the automotive industry was interested in the metal's potential to prevent engine knock when used as a fuel additive. It raised what is now called "octane," which is the anti-knock property of gasoline measured by iso-octane reference fuel."Octane rating" is an index of a fuel's ability to resistengine knockin engines having different compression ratios. This one is a feature of octane's branched-chain iso-octane. The gasoline octane rating is not related to the engine power output. Using gasoline of a higher cannot increase power outpu.

The anti-knock power of 2–4 grams of tetraethyl lead (TEL) suspended in a gallon of gasoline was discovered December 9, 1921, in Ohio. GM's vice president for research, Charles F. Kettering and colleagues had engaged in a broad search for antiknock fuel additives from 1916 to 1921 in order to improve engine compression and power."Division head Thomas Midgley had turned up many candidates and had met with a good deal of success in boosting antiknock before leaded gasoline was discovered" [2, p. 30]. Strong public pressure to clean up the air and water led to the Clean Air Act of 1970 which "mandated a 90% reduction in three major emissions: carbon monoxide, nitrogen oxides, and other hydrocarbons (mostly unburned fuel" [2, p. 98].

The best way to do that was to use an exhaust-system device -a catalytic converter as annexhaust emission controldevice. Lead would have to be taken out of gasoline because it ruined the platinum surfaces of the catalytic converter [1, 6].

GM had been working on catalytic converters for at least four years and it had produced cars that were designed for unleaded fuel21,99. In 1973, EPA announced standarts requiring a gradual reduction in the lead content of each refinery's gasoline pool. "At that time, the average gallon of gasoline had 2.2 grams of lead. The lead phase-down would start January 1, 1975, with a reduction to 1.7 grams and continue to 1979 with a reduction to 0.5 grams per gallon" [2, p. 101].

Automakers equipped new cars with pollution-reducing catalytic converters designed to run only on unleaded fuel starting in 1975 and 1976, and new unleaded gasoline pumps began appearing at filling stations. It was stated that new catalytic converter could help to reduce pollution.

40% of all gasoline sold was still leaded by 1985, but in July, the refinery pool standard of 1.1 grams per gallon has dropped to 0.5, then - further to 0.1 grams per gallon in 1986.

"Lead content in gasoline peaked in 1973 at an average of 2.2 grams per gallon, which amounted to about 200,000 tons of lead used per year in the United States. In 1995 leaded fuel accounted for only 0.6% of total gasoline sales and less than 2,000 tons of lead per year. Effective January 1, 1996, the Clean Air Act banned the sale of the small amount of leaded fuel that was still available in some parts of the country for use in onroad vehicles. (Fuel containing lead was still permitted for some off-road uses, including aircraft, racing cars, farm equipment, and marine engines)" [2, p.104].

In 1996, the International Bank for Reconstruction and Development (the World Bank) recommended global phase-out of leaded gasoline. The estimated benefits from savings in health care were stated to worth more than ten times the costs of switching to TEL alternatives. They "are commercially available and technically well understood"[2, p.107]. These consist of isomerization and alkylation processesbased on different catalyst systems and equipment configurations as well as the use of oxygenates (alcohols) that help fuels burn cleaner and more completely. That fact could be part of environmentally responsible lead phase-out strategies."Following a phase-down period, in 2000 the European Economic Community also banned most leaded gasoline. Laws prohibiting leaded gasoline have been adopted worldwide in recent years" [2, p.107].

Conclusion. Leaded gasoline is still being phased out in most developing countries. The most essential part of that approach was a phaseout of leaded gasoline for cars and trucks. But leaded fuels are appliedin motor sports. Still, some nations such as Iraq and Jordan continue to use leaded gasoline" [2, p. 110]. The transport sector is stated to be responsible fora quarterof energy-related global greenhouse gas emissions. It is set togrow to one third by 2050.

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PROSPECTS FOR THE DEVELOPMENT OF ECOLOGICAL TOURISM IN THE CRIMEA

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Аннотация. В статье рассмотрены теоретические аспекты реализации экологического туризма. Выделены ключевые подходы к его определению и интерпретации. Даны определения «природная среда», «экотуризм» и «экологически устойчивый». Представлены перспективные направления и механизмы развития экологического туризма на территории Крыма.

Ключевые слова: экологический туризм, охраняемые, экологически устойчивый, природные территории, Крым, развитие.

Annotation. The article considers the theoretical aspects of ecological tourism implementation. The key approaches to its definition and interpretation are highlighted. The definitions of "nature environment", "ecotourism" and "environmentally sustainable" are given. Promising directions and mechanisms for ecological tourism development of in the Crimea are presented.

Keywords: ecological tourism, protected, ecologically sustainable, nature areas, Crimea, development.

Introduction.

In the modern world, ecological tourism is intended to become a way to finance environmental protection activities and pursues urgent goals in the field of:scientific research; protection of fragile and untouched ecosystems that benefit the local population;promoting development of poor countries;increasing environmental and cultural sensitivity;environmental and social awareness of tourists; meeting the needs and training of legible tourists; building an ecological world around the world.

The issues of ecological tourism areinvestigated by many scientists. P.Wang, J.Wang, J. Zhang, X. Ma, L. Zhou, Y.study Sunchanges in ecosystem services and social-ecological drivers in a typical coastal tourism city [11]. X. Zheng, Z. Yang, X. Zhang, T. Wang, X.g Chen, C. Wang say that "the scientific evaluation of tourism ecological security (TES) is vital for promoting sustainable tourism development and ecological environmental protection" [13, p.114]. They proposed an improved Technique for Order Preference by Similarity to Ideal Solution method. D. Liu, Z. Yinconsidered "the conflict between ecological environmental conservation and fast tourism growth" [8, p.33. They noted that it was important to preserve the structure and function of the tourist destination ecosystem. The "Driver-Pressure-State-Impact-Response (DPSIR)" framework was applied to construct a multi-scenario simulation model. Xiaobin M., Biao S., Guolin H., Xing Z., Li L. said that "tourism ecological security is an essential component and basic guarantee of the tourism regional system, and it is of great significance for scientific measurement of the operational status of a regional tourism ecological security system" [12, p. 90]. D.N. Bagretsov, E.A. Khomutnikova, V.A. Korytkov, V.N. Kapitsky state ecotourism as an actual means of educating patriotism among student youth [2].

The purpose of our study is to consider the theoretical aspects of ecological tourism implementation as well as key approaches to its definition and interpretation.

The main part.Ecotourism is a kind of environmentally friendly form of tourism that tries to minimize its effect on the environment and avoid the negative impact of large-scale tourism developments in undeveloped areas.

Ecotourism is travel to relatively intact or uncontaminated natural areas for the specific purpose of exploring, admiring and enjoying the scenery, its wild plants and animals, and any existing cultural demonstration (both past and present) found in these areas [3, p. 22].

Ecotourism involves the active participation of students in the conservation and enhancement of the natural resources of their native landv[4]. As part of ecotourism, it is possible to organize activities for the care of native nature - cleaning the reservoir, cleaning up garbage in the forest, planting a forest. Ecotourism also includes scientific and educational trips in the fields of ecology, geography, archeology, ethnography. Within the framework of ecological tourism, it is possible to organize trips with "Spartan", extreme conditions - complex rafting, conquering mountain peaks, survival lessons in the forest, etc. Any formats of ecological tourism are a sense of duty and responsibility to the native land, country, people [2].

The Ecotourism Society defines ecotourism as "responsible travel to natural areas that conserves the environment and improves the well-being of local people" [10]. According to the Australian Ecotourism Association, ecotourism is nature-based tourism that involves education and interpretation of the natural environment and is environmentally sustainable.

These definitions recognize that "natural environment" includes cultural components, while "environmentally sustainable" implies proper return to the local community and long-term conservation of the resource. [3, p. 42].

However, mass tourism is seen as a more traditional form of tourism development, where short-term free market principles prevail and revenue maximization is essential The development of the tourism industry was initially is a desirable and relatively "clean" industry for countries and regions. This is especially true of the benefits of foreign exchange earnings, employment and infrastructure development such as transportation networks.

There is an opinion that conventional mass tourism has few positive qualities for the destination region, its inhabitants and their natural resource base. This is not at all a denial of mass tourism, but rather a statement that there is a justified need to find an alternative approach to its development that reduces negative consequences.

Based on the data of the analysis of state support for eco-tourism, we can say about some of its shortcomings:

1. Lack of an integrated approach to supporting eco-tourism. So, in the Federal target program "Development of domestic and inbound tourism in the Russian Federation for 2019-2025" mentions issues related to ecological tourism, however, only one territory is indicated as a priority - the Baikal region, where it is proposed to implement integrated investment projects for the integrated development of this territory. The program pays attention to tourism issues, however, ecological tourism is considered only within the framework of one ecological zone. [7, p. 45].

In addition to the theses about the lack of an integrated approach, we drew attention to the National Project "Ecology", namely the project "Conservation of biological diversity and development of ecological tourism". In this project, the target indicators are: the area and number of specially protected natural areas (SPNA), as well as the number of visitors to SPNA. The main forces are aimed at developing the legal framework and guidelines for the development of eco-tourism. If we consider the proposed activities, then within the framework of direct financing, the emphasis is on the development of conditions for people with disabilities, which, in our opinion, are not tasks of paramount importance [6].

It is proposed to supplement the Federal target program with territories promising for the development of ecotourism: These are the Astrakhan, Altai, Karelian, Far Eastern regions, the Republic of Crimea, etc. An important task is the uniform coverage of ecotourism throughout Russia, since fragmentation was marked by one of the significant problems [7].

The funds of the national project can be redirected to the organization of tourist camps, as well as public-private partnership (PPP) projects, including those with the participation of regional authorities [6].

2. Direct financing, which, as a rule, comes down to financing the issues of maintaining the activities of protected areas. Despite the impressive

amount of funding, funds are spent mainly on maintaining ecological diversity, sanitation, maintenance and protection of the forest. In our opinion, it is possible to organize trails and install navigation at the expense of subsidies, and not understand such activities as one of the key goals of the project. This is not such a significant cost, up to 10% of funds can be spent annually on the equipment of ecological trails [9].

It is proposed to provide for an increase in the level of annual funding to 200 million rubles. from the Federal budget and additional funds within the framework of regional programs, which will help meet the needs for the maintenance of protected areas, as well as provide additional opportunities for the installation of navigation stands, equipment for trails and parking lots [6, p. 18].

3. Grant support for ecological tourism on a par with other economic and social sectors. Currently, grant support is provided either by the Presidential Grants Fund or by regional structures responsible for the economic development of the territory. The problem is that grants are awarded on the basis of the same importance of all areas. At the same time, environmental projects have an increased payback period.

It is necessary to revise the methodology for evaluating projects within the framework of the Presidential Grants Fund. For example, these may be certain quotas for environmental projects. Currently, no more than 50 million rubles of such grants are issued annually in the Russian Federation. The presence of a quota for grants will provide targeted funding and provide specific support to business and environmental projects [3].

In addition to the considered directions for improving the strategies for the development of ecological tourism, we assume that additional support measures can be implemented, taking into account foreign experience[9-13].With a certain amount of funding, the following instruments are included in the project related to eco-tourism:preferential conditions for land lease for 49 years;preferential tariffs for gas, water, electricity;preferential rates on loans; cancellation of VAT for 5 years, cancellation of customs duties.This issue needs to be addressed at the federal and regional levels. For example, for the Republic of Crimea, it is possible to subsidize the payment of tariffs for utilities in the amount of 50%, compensate for part of the interest rate on a loan, introduce a VAT reduction factor of up to 10% or 0%, as well as a reduced rental rate for large investment projects.

In order to increase the attractiveness of the use of the PPP tool in the field of eco-tourism, we propose the following activities:

1. Compile a list of promising environmental projects and publish them on the investment portal of the region (available in each region) indicating specific types of activities, prohibitions and restrictions, as well as the proposed infrastructure and financial state support. 2. Create a council for the implementation of PPP projects in the field of ecological tourism to maintain a balance of public, state and private interests.

3. Use the proposed measures to support environmental projects, including for PPP projects.

4. To form a list of promising environmental projects and their publication on the investment portal of the region (available in each region) indicating specific types of activities, prohibitions and restrictions, as well as the proposed infrastructure and financial state support.

5. Introduce work within the framework of PPP in the "single window» mode to reduce the time and costs of the investor.

Conclusion.We believe that the proposed set of measures will increase the attractiveness of the PPP tool, since investors will see ready-made projects that have passed public discussions, with clear "rules of the game" for everyone, without fear of cooperating with regional authorities and incurring public risks. The increased responsibility of the state in such projects, as well as additional benefits provided, will be able to further stimulate investors.

Thus, an integrated approach to ecological tourism in the Crimea, which includes both competent goal-setting and the distribution of resources between goals, is a necessary condition for high-quality development. We believe that PPP will help to make a breakthrough in the development of ecological tourism infrastructure and solve its significant problems.

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SECTION 7:MEDICINE



UDC 617-089.844:615.36:611-013.85-032 GENETIC ENGINEERING - XENOTRANSPLANTATION

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Аннотация. Исследование было разработано для анализа вопросов трансплантологии и рассмотрения инноваций, которые трансплантологии. Описаны будущее возможности изменят ксенотрансплантации. Это пересадка органов или тканей животного происхождения человеку-реципиенту. Автор констатирует, что исследователи и хирурги уже несколько десятилетий работают над жизнеспособными вариантами ксенотрансплантации, чтобы решить проблему спасения жизни человека. В заключении подчеркивается, что в ближайшее время ученые могут начать новую фазу клинических испытаний на люлях.

Ключевые слова: ксенотрансплантация, клиническое исследование, пациент, почка, трансплантат.

Annotation. The study was designed to analyze the issues of transplantation and consider the innovations that will change the future of transplant. The possibilities of xenotransplantation are described. It is the transplantation of organs or tissues from an animal source into a human recipient. The author states that researchers and surgeons have been working towards viable xenotransplant options for some decades in order to decide the problem of human live saving. In the conclusion it is emphasize that scientists can begin the new phase clinical trial in humans soon.

Keywords: xenotransplantation, clinical trial, patient, kidney, transplant.

The level of development of modern surgery, armed with various technicalmeans, allows to transfer many types of operations into the category

of organ-preserving, but does not fully realize the biological potential of the organism. Currently, genetic engineering is used by scientists to enhance or modify the characteristics of an individual organism [8]. One of the directions of development of regenerative surgery can be tissue transplantation as a biological method for stimulating reparative regeneration. The main advantage of xenotransplantation is the possibility of fabric procurement in a large volume, which may have the character of a serialproduction. But there are disadvantages in xenotransplantation as well. One of the essential concerns with a transplant is the risk of rejection where the body's immune system destroys donor organ as foreign. Researchers have been working towards viable xenotransplant options for a long period in order to save more live as well as improve the quality the patients' life [5, 7].

While the positive results present how xenotransplantation can address the worldwide organ shortage crisis a huge number of people are waiting for a kidney transplant. "There is much curiosity surrounding what this procedure looks like and what it means for the future of science in this field" [11]. Many surgeon state that "unless the donor and recipient are identical twins, some rejection is inevitable" [10].

J. Carvalho, M. Peixoto described new design as a therapy against cancerous and genetic diseases [3]. The issues of genetic engineering strategies for sustainable polyhydroxyalkanoate production from carbon-rich wastes were considered by J.Wang, S. Liu, J. Huang, R. Cui, Y. Xu, Z. Song [9]. Z. Jiang, Yi Xu, M. Fu, D. Zhu, N. Li, G. Yang analyzed genetically modified cell spheroids for tissue engineering and regenerative medicine [2].

The term "*xenotransplantation*" is referred to the organs or tissues transplantation from an animal source into human recipients.

David Cooper was a xenotransplantation pioneer. His early work provided with information about genetic engineering.

Bartley Griffith has "done over a thousand heart transplants over a career that has spanned four decades" [10].

In the USA, the surgeon had to transplant a pig's heart to a patient - 57year-old David Bennett. Due to problems with arrhythmia, the man's heart could not work in good condition, therefore, soon the man died. Because of non-compliance with the recommendations of doctors, Bennett's condition deteriorated to a hopeless state, so he had no choice but to transplant his heart, but, due to the man's bad reputation as a patient, he was refused to donate an ordinary heart, besides, the human heart did not fit well enough to the human body, so Bennett had to agree to a very a strange operation – a pig heart transplant for him. There have already been moments in history related to the transplantation of animal organs to humans, but the heart is nonsense in medicine and science [2]. The first attempt of such an operation was made back in 1964. "Cardiac xenotransplantation," or the transfer of a heart between species, was first performed in 1964 with a human recipient: University of Mississippi surgeon James Hardyimplanted a chimpanzee heart into the 68-year-old Boyd Rush. At least eight other similar cardiac xenotransplants took placeover the next half-century, none of them quite successful [10].

The donor pig's heart was not ordinary, but modified. The organ was provided to the person by a company Revivicor that is "focused on developing genetic biotechnology platforms to provide alternative tissue sources for treatment" [6].She made a genetic change in the heart that could be more likely to suit a person. The result is disappointing Two months after the operation, Bennett died, and it is still not clear why, since doctors have not established a diagnosis.Hirigu Griffith, who performed the transplant, said that the heart had almost doubled in size. Because of this, the vessels began to be damaged, resulting in internal bleeding [1].

What will happen next?

There are many diseases scientists need to research and work through new techniques.



Picture 1 – Organs shortage all over the world. More people are waiting for kidneys than other organ.

The key questions are: Why is this significant? How does the innovations change the future of transplant? That is why more clinical trials are necessary.

There is an acute of organs shortage all over the world, the most common one being the kidney as kidney illness kills more people every year than cancer (according to the recent data of National Institute of Diabetes and
Digestive and Kidney Diseases). Though transplantation is the best treatment for disease, only a small number of. those are performed each year. Many people on dialysis die every day. "Many of these deaths could be prevented if an unlimited supply of kidneys were available for transplant".

The wait for a deceased donor kidney can be as long as five years, and in many states, it is closer to 10 years. Almost 5,000 people per year die waiting on a kidney transplant" [4]. Radical solutions are needed. Xenotransplantation affords the way to determine a source of novel organ and provide a kidney for every man in need.

Doctors and scientists from all over the world are not going to stop there. Despite the disappointing results with Bennett, they will continue to try to carry out similar operations. It is not yet clear how to perform this operation, many people continue to die without waiting for vital organs. It ia clear that science is taking leaps and bounds in our time.Due to clinical trial it will be possible to carry out such operations quite easily and successfully.Scientists should pursue the safest and fastest path forward to bring the groundbreaking technologies to patients in need.

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SECTION 8: PSYCHOLOGY AND PEDAGOGY



UDC 37.017.4 ББК 74.200.50 FUNDAMENTAL ASPECTS OF THE PEDAGOGICAL HERITAGE OF V.A. SUKHOMLINSKY

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Аннотация. R данной раскрывается статье значение педагогического наследия В.А.Сухомлинского, направленного на воспитание всесторонне развитой личности. Автор статьихарактеризует основные идеи воспитательной системы педагога- новатора, критерии ее эффективности. Особое внимание уделено проблемам содержания образования, мотивам познавательной деятельности, методам работы педагога. Автор стремится раскрыть значение трудового воспитания для развития личности. В статье дана оценка вклада В.А. Сухомлинского в теорию и практику воспитания новой личности. В заключение автор подчеркивает актуальность педагогического наследия В.А. Сухомлинского в современном обществе.

Ключевые слова: В.А. Сухомлинский, педагогика, педагогическоенаследие, воспитание, обучение, развитие, личность, учитель, ученик, коллектив, друг, любовь, гуманистичность, эксперимент, гражданственность, интеллектуальный фон класса, Павлышская школа, природа, труд, семья, музыка, слово, актуальность.

Annotation. This article reveals the significance of the pedagogical heritage of V.A. Sukhomlinsky, aimed at educating a comprehensively developed personality. The author of the article characterizes the main ideas of the educational system of the teacher-innovator, the criteria for its effectiveness. Particular attention is paid to the problems of the content of education, the motives of cognitive activity, and the methods of the teacher's work. The author seeks to reveal the importance of labor education for

personality development. The article evaluates the contribution of V.A. Sukhomlinsky in the theory and practice of educating a new personality. In conclusion, the author emphasizes the relevance of the pedagogical heritage of V.A. Sukhomlinsky in modern society.

Keywords: V.A. Sukhomlinsky, pedagogy, pedagogical heritage, education, training, development, personality, teacher, student, team, friend, love, humanism, experiment, citizenship, intellectual background of the class, Pavlysh school, nature, work, family, music, word, relevance.

Inroduction.Pedagogy as"art of education" is a science of the education and training of a person. A science that reveals the principles, methods and technologies of training and education. However, the upbringing of a person is rather an art. And no, even the best textbooks can teach this art. Perhaps that is why we consider the experience of people with such attention who were endowed with a genuine talent as educators.

The purpose of given article is to reveal the significance of the pedagogical heritage of V.A. Sukhomlinsky, aimed at educating a comprehensively developed personality.

The main part.There are a lot of wonderful teachers in Russia who have made a huge contribution to the development of pedagogical culture in our country. One of such wonderful teachers is Vasily Aleksandrovich Sukhomlinsky.

There is a child with their activity, interests, individual creative abilities in the center of the educational system created by V. Sukhomlinsky. The main task of the teaching staff of the school is to create favorable conditions for the formation and development of the personality. According to Sukhomlinsky, education is not child's disadvantagesovercoming but the development of the best features of a person. Not power and submission, but respect and love should be at the heart of learning. "Real education consists in gradually melting the ice in a child's heart, so that your pupil's heart itself radiates warmth" [6, p. 30].

"If a teacher has become a friend for a child, if this friendship is presented by honorable attraction, an impulse towards something bright, reasonable, evil will never appear in the heart of a child. And if there are alert, bristling, distrustful, and sometimes angry children in schools, it is only because the teachers did not recognize them, find an approach to them, manage to become their comrades. Parenting without friendship with a child can be compared to wandering in the dark.

The main and decisive in pedagogy V.A. Sukhomlinsky had love for the child. It is the greatest humanistic pedagogy of V.A. Sukhomlinsky attracted unflagging interest in him all over the world. His works have been published in English, German, French, Polish, Spanish, Japanese and many other languages.

The determining value of V.A. Sukhomlinsky attaches to the backbone factor - the focus of all educational work on the formation of high moral qualities in schoolchildren. V. A. Sukhomlinsky developed and successfully implemented a new research method in pedagogy - an experiment characterized by the unity of three components: integrity, collective creativity and duration.

It was due to the application of this method in the study of the problems of educating a comprehensively developed personality that results were achieved that marked a significant contribution to the development of the theory of pedagogy [1].

Sukhomlinsky paid the main attention to the education of the younger generation of citizenship. "Being a citizen in every respect means, above all, caring about the future of society, and the future is children."

He continued the development of the doctrine of the educational process in a team, developed a methodology for working with an individual student in a team. Sukhomlinsky introduces a new concept of the "intellectual background of a class" [7]. The interaction of various interests and hobbies, the exchange of spiritual acquisitions, knowledge increases the "intellectual background", raises the general level of children's development, causes a desire to learn more and thereby helps in the main thing - in learning, as it is a main joint work in the school team.

In the book "I give my heart to children", Sukhomlinsky clearly showed that the success of the work of an educator aimed at the harmonious development of children is possible only with a deep knowledge of the spiritual life and developmental characteristics of each child.

A talented practitioner and theorist, he worked all his life in a rural school.He turned the Pavlysh rural school into a real laboratory of advanced pedagogical experience, which not only Soviet, but also foreign teachers came to get acquainted with. He was one of the first to start preparing six-year-old children for schooling. He developed Makarenko's idea about the expediency of creating groups of pupils of different ages (labor detachments of the II brigade, subject, technical, agricultural circles, amateur, art groups, student groups at the place of residence of students, etc.). Sukhomlinsky's talented discovery was the "school under the blue sky" [4, p. 31], or, as it was called, the "school of joy".

The method of educating the team based on experience of the Pavlysh school, was not built on aperson's spiritual wealth development, their needs, the readiness to bring the fruits of one's "individual spiritual activity" to the team and enrich themselves in spiritual communication [5]. It was nature that V.A. Sukhomlinsky considered the source of beauty [8]. Nature is a source

of human education. He also believed that the process of educating a harmonious personality is impossible without the knowledge of beauty. It is the appeal to beauty, the ennoblement of the soul, the experience of beauty that removes "thick skin", refines the child's feelings so much that he becomes receptive to the word, and therefore becomes educated.

Music is the most miraculous, the most subtle means of attracting to goodness, beauty, humanity. Listening to music, a person learns that he/she is born to be beautiful, and if there is something bad, then it must be overcome.

Much attention was paid to listening to music in his school.

In the theory and practice of the Pavlysh school, great importance was attached to work, which was the basis for the upbringing of a new person. The solution to the problem of strong meaningful knowledge is possible under the condition of exerting one's own efforts, achieving success by labor, the joy of mental labor - these three steps on the path of knowledge. "All the blessings and joys of life are created by labor. One cannot live honestly without labor... An idler, a parasite is a drone devouring the honey of industrious bees. Education is your first job. Going to school, you go to work" [9, p. 445]. Sukhomlinsky's Ph.D. thesis (1955) was devoted to the system of labor education in a rural school. Over the next fifteen years, this system was continuously improved, providing students with ever greater opportunities to satisfy their labor interests and inclinations.

The main method of the teacher's work was the word. According to Vasily Alexandrovich, the word should be meaningful, have a deep meaning, emotional saturation, should be addressed to a specific student and be distinguished by truthfulness.

Sukhomlinsky called the word "the thinnest touch to the heart", which can make a person happy and unhappy [8]. "The word is a powerful, omnipotent, subtle tool that, in skillful hands, can do everything." The power of the word in education is great, and every teacher should remember this. The majority of school conflicts occur because of the inability of teachers to use the gift of words or because of the fear of "closed" topics that, with the right approach, can give the child moral standards [7]. The word is something like a bridge through which the science of education turns into art, mastery.

The teacher paid special attention to the family in the upbringing of the younger generation.

He wrote that not only the school educates, but also the family, and from the first day of the child's existence, it performs the same functions. Therefore, the family and the school must develop together.

The legacy of V.A. Sukhomlinsky does not lose its significance, but is becoming increasingly relevant. Every year the experience of a teacher attracts more and more attention of the world scientific and pedagogical community, both in our country and abroad. And this is no coincidence. The pedagogical system developed by him not only enriched pedagogical science with innovative ideas and provisions, made a contribution both to the theory and practice of education and upbringing, but also constituted a significant, revolutionary stage in the development of domestic pedagogical thought. In the creative heritage of V.A. Sukhomlinsky the problems of the content of education, motives for cognitive activity, methods of teaching children, control and management of the educational process, teacher training, and many others are considered.

. V.A. Sukhomlinsky is a humanist, thinker, and teacher. In the main book of his life, "I give my heart to children," he wrote, "What was the most important thing in my life? I answer without hesitation: love for children" [8]. He devoted his whole life to children, gave them his heart, felt every child's soul.

The educational system of V.A. Sukhomlinsky anticipated many achievements of modern pedagogy. His works touch upon such problems as an individual approach, developing methods and game forms of education, the relationship between school and family education, etc. It can be said with confidence that at the moment Sukhomlinsky's ideas in the forms transformed to modern times are applicable, in particular, in higher educational institutions [1]. For example, in our university, students have an excellent opportunity to combine basic studies in various fields: science, culture, sports. Volunteer movement, student groups, competitions, environmental and other various actions. They allow to interact with the outside world, society, nature, but primarily aimed at developing and improving the personal qualities of each individual student [10]. One of the clearest examples of the so-called "learning process" that can be continued outside the university with pleasure is the organized joint action of the Sevastopol State University and the Lunacharsky Theater called "Student Tuesday". This event is unique in that, in addition to the unique opportunity to enjoy the performance, students can talk with the actors involved in each particular production, thereby looking at the world of art from a new perspective. It is possible that such an interest may encourage someone to new achievements. After all, this is exactly what Vasily Alexandrovich meant in our opinion, rightly arguing about the need to broaden one's horizons and aesthetic education.

One should make a **conclusion** that there are also a confident civic position, love for nature, the desire for knowledge along with aesthetics and beauty everywhere at all levels of education. The most important thing is love for life. This is what Sukhomlinsky teaches us. Currently our society faces the great goal of educating a new personality, free, capable of active,

creative activity in all spheres of life. And if we want to achieve this goal, we will certainly need the wisdom of this great teacher.

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STUDENT VIEW ON CULTURALCONTROL PROBLEM IN THE SPHERE OF PHYSICAL EDUCATION AND SPORT EvgeniyDanilov

1st year students, Department of Physical education and sport, SevastopolStateUniversity Olga Golovko Professor, assistant professor Аннотация. В статье раскрыто значение метода эссе для диагностики направленности личности студента магистратуры по профилю подготовки «Образование в области физической культуры и спорта». Представлено студенческое эссе, посвященное проблеме культурного фильтра в сфере физической культуры и спорта. Показана роль самовыражения в учебной деятельности студентов.

Ключевые слова: эссе, самовыражение, студенты магистратуры, образованиевобластифизическойкультурыиспорта, культурный фильтр.

Annotation. The article reveals the significance of the essay method for diagnosing the orientation of a master's student personality in "Education in the field of physical training and sports" field. A student essay is presented devoted to the problem of the cultural filter in the field of physical training and sports. The role of self-expression in the educational activity of students is shown.

Keywords: essay, self-expression, master's students, education in the field of physicaltraining and sports, cultural filter.

Introduction. Sevastopol State University trains master's students in the direction of "Pedagogical education" (profile "Education in the field of physical training and sports"). A significant part of themcomprises the interested students who are also teachers or sport coaches.

Master's training is due to students' need to receive deepen pedagogical education in order to solve tasks of increased complexity in production. In addition, master's students receive an additional professional right to teach in higher education according to the profile of training.

Physical education and sport department should decide a serious task – to form and develop important qualities of a professional teacher who masters pedagogical skills and innovative technologies in the field of physical training and sports.

The subjective of given study is to state the main peculiarities of the essay method for diagnosing the orientation of a master's student personality in "Education in the field of physical training and sports" field.

The main part. In the process of studying the special subject "Methodology of Pedagogical Research in the Field of Physical Training and Sports" (MPR-FPTS), it is advisable for Master's students to provide the opportunity for research activities based on scientific works, empirical methods and personal experience [2]. This approach justifies itself in the sense of personality-oriented and practice-oriented education, allows

revealing and directing the student's professional interest, enriching one's ideas about their place in the profession [1].

Particularly valuable in this regard are methods aimed at self-expression of students and their assessment of various pedagogical situations, problems, trends. In this case, the teacher can observe not only external manifestations, but also the inner world of the student's personality.

One of the effective methods of self-expression, in our opinion, is the essay method (translated from French as "reflection") as a brief reasoned statement of one's own point of view on an actual problem. The presentation of an essay at a practical lesson in the subject contributes to the mutual enrichment of the students of the group, the organization of a constructive discussion.

We practice such an essay in the first lesson of the MPR-FPTSsubject as a control test, where studentshave to think about the value aspects of the professionas a self-actualization task.

One should cite as an example an essay by a master's student and sport coach E.A. Danilova.

Essay on the topic "The problem of cultural filter in the field of physical training and sports"

"When discussing the problem of the cultural filter in the field of physical training and sports, it is necessary, first of all, to understand what culture and cultural filter are. Having looked into S.I. Ozhegov's dictionary, we can read that culture is a set of industrial, social and spiritual achievements of people. So, it is worth finding out whether activities and achievements in the field of physical training and sports are so significant for society as to serve as a cultural filter.

One must consider this issue from the perspective of privilege. At the legislative level, for athletes who have achieved especially high sports results, there are a number of benefits enshrined, for example, in Article 32 of the Federal Law No. 80 of April 29, 1999 "On Physical Training and Sports in the Russian Federation".

Undoubtedly, it should be taken into account that in addition to various benefits and bonuses, athletes with high merit are popular and respected in society. This often allows them to earn big money and influence public opinion through the media. This fact helps to complete the idea of promoting athletes in society through various privileges and move on to more spiritual values.

I am sure that it is difficult to dispute points of difference between an ordinary man and a person associated with physical training and sports. Such differences relate to their thinking, worldview, values, and so on.

It doesn't matter whether a person goes in for sports, basic physical culture or background types of physical training- he/she will undoubtedly differ in the spiritual component from a person who instead of exercising preferred a morning smoke break, instead of proper nutrition - fast food, instead of a walk - evening on the couch. Physical training and sports "make" people who have embarked on the path of creation.

They create themselves not only spiritually and physically, but also help others to take the right choice by means of their example, thereby building a better society. Of course, there are people who have significant merit in sports but they are not an example to follow due to their actions or lifestyle. These cases are undeniably exceptions.

Based on the mentioned text, we can conclude that physical training and sports, of course, represent a kind of cultural filter for today's society. And people who bring sports and a healthy lifestyle are the creators of a cultured, strong and healthy society, which entails a bright future for their state."

Conclusion. The presented example of a student essay clearly demonstrates the advantages of this teaching method in diagnosing the orientation of a student's personality, one's priorities and grades. Such creatively oriented methods of professional training of a master's student can serve as the basis for its disclosure and building a further learning trajectory in accordance with the social order for the of a creative, competitive person formation of future professional teacher.

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UDC 37.013

CONCEPT OF PEDAGOGICAL ACTIVITY STYLE

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lecturer,Chair of Interculural Communication Sevastopol Institute of Education Development e-mail:drozdan72@yandex.ru **Yulia Petrunina** senior lecturer,Theory and Practice of Translation Department, SevastopolStateUniversity Аннотация. Рассмотрены проблемы формирования творческого стиля педагогической деятельности. Представлены условиям формирования убудущих учителей творческого стиля педагогической. Описаны основные элементы структуры личности учителя с творческим стилем педагогической деятельности.

Ключевые слова: стиль, творчество, деятельность, гуманизация, самоорганизация.

Annotation. The problems of a creative style formation of teachers' pedagogical activity are considered. The conditions of future teachers' creative pedagogical style formation are resented. The main elements of the teacher's personality structure with a creative style of pedagogical activity are described.

Keywords: style, creativity, activity, humanization, self-organization **Introduction.**

Modern transformations, social and technical challenges require certain changes in the educational sphere as an important state institution. The priority areas of pedagogical institutions is a style formation of future teachers' educational activity, which sets the task of developing professional and pedagogical abilities, intuition, and professional erudition of a teacher as the basis for high performance in pedagogical work. The teacher needs a creative style of pedagogical activity.

The subjective

The purpose of this article is a theoretical substantiation of the problem of a creative style formation of future teachers' pedagogical activity, which we consider a multi-component education.

Methodological base of the study.

Methodological and theoretical approaches to solving the problem of forming a competent teacher are reflected in the works of I.D. Frumin [4], O.V. Ilchenko [2] and others. The theoretical and practical domain constituted by pedagogy was investigated by N. Friesen, K. Kenklies [10].

The main competencies as a component of student-centered education were considered by A.V. Khutorskoy [5]. Effective educational technologies were analyzed by V.I. Zagvyazinsky [1]. R. M. Murray, C. M. Sabiston, P. Coffee, K.C. Kowalski studied how psychological processes associated with physical activity could affect the strength of this relationship [14].

Teachers' pedagogical leadership in activities was considered by M. Boe, J. Heikka, T. Kettukangas, K.Hognestad [7]. M. Nores, A. Friedman-Krauss, A. Figueras-Daniel proved that pedagogical process quality may be dependent on teachers' activity [15]. B. Almukhambetov, M. Tanirbergenov, Z. Nebessayeva say abour the art-pedagogical activity of a teacher [6].

Results of the study

The development of ideas about the style of pedagogical activity is associated with the concept "activity". The approach of domestic psychologists and teachers to activity characterized it as the main condition for the formation of the psyche as a dynamic phenomenon that develops in the process of activity [12].

In general, the style of pedagogical activity should be based on the following principles:

- the principle of humanism - the humanization of relations;

- competencies - creating conditions for the comprehensive development of the individual;

- pedagogical self-development - creating conditions for meeting the needs for self-development.

The effective conditions for the formation of a creative style of pedagogical activity in future teachers include: scientific and methodological; organizational and managerial; psychological and pedagogical; technological [17]. The content component of the style of pedagogical activity is creative, which is in presence of creative thinking, a critical assessment of one's capabilities, recognition of the dignity of others, independent professional activity, creative mutual influence of individuals, sustainable self-regulation. The development of the personality is the formation of his or her worldview: morality, spirituality [11], one's ecological culture, aesthetic ideals, sense of duty and responsibility, respect for history, acceptance of culture and norms of behavior.

It is important to form self-organization(increased satisfaction and joy at work) [16]. Happiness at work is much more about emotions. "Emotional state over time has a hugeeffecton ourwell-beingandperformance. Satisfaction, on the other hand, turns out to have much fewer beneficial effects. Indeed, there is a weak correlation between job satisfaction and employee performance but a much stronger correlation between a positive emotional state and job performance" [11].

In the process of pedagogical activity, an integral structure of the personality of future teacher is formed. The need for a creative style of activity interacts with consciousness, imagination, thinking, will and memory. Creativity is subjective. It is necessary to involve teachers in dynamic professional activities, during which a positive emotional attitude to future pedagogical activity is strengthened [11]. Creative cognitive style influences "success through affecting conflict handling style" [8, p. 906].Motivation influences on"positive intervention results in social awareness, self-control, self-esteem, social isolation and social anxiety..." [9, p.29].

The content elements of the integral structure of the personality of a future teacher with a creative style of pedagogical activity are:

-the implementation of an appropriate system of self-government;

-purposeful scientific and methodological support of training;

-the formation of the worldview of students through the humanities.

In conclusion, it should be noted that the creative style of the teacher's activity determines the success of pedagogical activity and is the result of a high level of self-organization(increased satisfaction and joy at work).

It is the development of creative individuality that will ensure the effectiveness of the teacher's activity, will allow solving educational problems with the greatest effectiveness and getting satisfaction from pedagogical work.

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VOLUNTEERING AND ITS BENEFITS

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Аннотация. В данной статье рассмотрены Основные направления добровольческой деятельности в Севастополе. Автором представлены примеры участия студентов Севастопольского государственного университета в волонтерском движении региона.

Ключевые слова: волонтер, Севастополь, культурное волонтерство, добровольческие центры, экологическое волонтерство.

Annotation. This article discusses the main areas of volunteering in Sevastopol. The author presents examples of Sevastopol State University students' participation in the volunteer movement of the region.

Keywords: volunteer, Sevastopol, cultural volunteering, volunteer centers, environmental volunteering.

Introduction.Currently more volunteer organizations appear in the world. Volunteering is becoming popular in our country among young people. "Volunteering offers vital help to people in need, worthwhile causes, and the community, but the benefits can be even greater for you, the volunteer" [13].

The issues of helping people were discussed by many scientists. Today, this is a particularly urgent problem, since in an unstable world there are many socially unprotected people who are needed a support and assistance. N. Kahana [11], D.D. Bajrami, M.Cimbaljević, Y.A. Syromiatnikova, M. D. Petrović, T. Gajić [9], D. Jaime, P.Martínez, D.Contreras, C.Bonacic, M.O. Marín deal with concepts of volunteer organizations their work [10].

This article is amed at the description of the main areas of volunteering in Sevastopol.

Help is needed in every sphere of life. Earlier, small groups of volunteers formed into a mass movement. Probably, the events of the modern affairs, such as the pandemic, have shown how important volunteering is. Volunteers are people of various professional branches, but they have one thing in common – the desire to make the world a little better by helping others [5].

"The decisive factor in the successful organization of voluntary work of citizens are additional tasks that are formed on the basis of the needs and interests of the volunteers themselves, taking into account their age groups, and are directly related to motivating people to volunteer work" [1].

Now it is difficult to find an area in which there is not a single volunteer. The Russian Federation classifies volunteers as individuals who are engaged in voluntary activities on a gratuitous basis, in the form of work and services, at events or in funds to help different moods. Since 2018, volunteering and volunteering have been considered one and the same [3].

In its activities in the field of "Volunteering"Sevastopol Institution is regulated by the following documents, and legal acts:Federal Laws of the Russian Federation; Federal Law "On charitable activities and volunteering (volunteering)" dated August 11, 1995 N 135-FL (last edition); Government of the Russian Federation; Department of labor and social protection of the population of Sevastopol; Order dated November 11, 2019 No. 587 On the organization of voluntary (volunteer) activities in the State Treasury Institution "Sevastopol City Integrated Center for Social Services"; Order No. 161 dated April 6, 2020 On amendments to the order dated November 11, 2019 No. 587 "Sevastopol city complex center of social services""On the organization of voluntary (volunteer) activities in the State public institution" Sevastopol city complex center of social services" [8].

Volunteering is not paid, so why are young people still going there, the so-called "hungry students"? And why does volunteerism not lose its popularity, because you often have to work with unpleasant people and in difficult conditions?

Firstly, volunteering allows a person to show their best abilities. If there are creative ones, talents and special skills, they will definitely be revealed. After all, people need not only material, spiritual aspect is important a well. Volunteer centers organize creative events for which one needs to prepare various numbers [12].

Secondly, being energetichas a great influence on people. They form an active life position, and it increases the level of emotional and psychological balance [6].

The third fact can be considered the development of communication skills.Many people feel lonely, they do not know where to find an interlocutor. Communication among people who are ready to help many people just like that can have a beneficial effect on a person [6].

And, probably, the most common reason is the high benignity of the human heart. It may be hard to believe, but many have a sincere desire to do good things, give more than receive. Life can be hard, so why not make it better on your own? Good deeds done disinterestedly fill our hearts with bright feelings [2].

There are various areas of volunteering.

1) Social volunteering is revealed as helping people in need. A support of orphans, helpless pensioners, people with disabilities are urgent issues in our country. Each person has an individual story. Everyone needs a separate approach and different help. Lonely people need a warm conversation, someone needs help with movement. Thus, volunteer organizations become an instrument of socialization of the population and state assistance [4].

2) Environmental volunteering is now gaining popularity, perhaps due to the fact that the environmental situation is deteriorating every year and we are increasingly witnessing the consequences of environmental disasters.

Such activities can have many variations - from the conservation of flora and fauna through strikes and pickets to the planting of forest belts and subbotniks [8].

3)One of the areas of volunteering is donation. Donating blood is easy at first glance. For quality delivery, you need to monitor your health, eat right and avoid bad habits. 4) Cultural volunteering has been and remains in demand. Many students know foreign languages and this helps to participate in events as coordinators, where you need to communicate with foreign guests at exhibitions and festivals [3].

Volunteering is quite actively developed in Sevastopol. There are many organizations - from the Russian Student Squads to the organization #We are together. I am personally a member of several and gladly respond to calls for help. My favorite type of volunteering is helping animal shelters. This is an indescribable feeling when you are surrounded by fluffy creatures who are happy to see you and who gives you their attention.

In November 2016, the Volunteer Center "Fregat" of Sevastopol State University was established as an association on the initiative of students that engages in attracting volunteers, organizing and conducting volunteer activities. Prospects are presented for students: to solve urgent problems of society; participate in exciting events and promotions; meet and communicate with famous people; travel around the region and the country together with interesting and enterprising people [3].

There are the following thematic volunteer associations:

Dobrodei: The event association "Dobrodei" is a volunteer activity aimed at helping to organize and conduct significant events at the university, regional, all-Russian, international levels (assistance at conferences, congresses, forums, holidays, concerts, etc.).

Hope Vector: Social Association "Vector of Hope" - volunteer activities aimed at providing social assistance: donation, activities with children from orphanages and assistance in animal shelters.

Zelenka: Ecological association "Zelonka" is presented by volunteers which are engaged in eco-education, organize and take part in events dedicated to the separate collection of waste and waste paper, organize the separate collection and processing of waste at the University, call for the conservation of water resources, hold community work days and are engaged in gardening.

CyberAgentyIB Cyber Security Association: volunteers search for illegal content on the Internet that is extremist or terrorist in nature. Prohibited video and audio content, as well as text information, are blocked through the Roskomnadzor website. Provide training to schoolchildren on cyber literacy.

Volunteers of Victory: Victory Volunteers are volunteer activities aimed at civil-patriotic education, restoration and preservation of historical memory. Volunteers help organize all-Russian and international events, take care of veterans, help improve memorial sites, restore family history and prevent the world from *forgetting and rewriting the true story*.

Storm: Sports Association "Storm" are volunteer activities aimed at organizing sports events, maintaining and promoting a healthy lifestyle of students and involving them in physical education and sports.

FinGram: FinGramSev Economic Association is a volunteer activity aimed at promoting and developing financial literacy among students and the public, as well as their involvement in economic activities.

There are 287 volunteer organizations in Sevastopol. The following volunteer organizations exist in Sevastopol:

public volunteer movement "We Regional are together Sevastopol"; Volunteer center on the basis of GBUK city of Sevastopol "Palace of culture of fishermen"; Regional branch of the all-Russian public movement to perpetuate the memory of those who died in defense of the fatherland "Search Movement of Russia" in the city of Sevastopol; All-Russian public movement "Medic Volunteers"; All-Russian student rescue corps; Autonomous non-profit organization "Resource Center for Support of SO NPOs"; ANO "Center for Social and Cultural Initiatives" VECTOR OF GOOD "; Sevastopol public movement "Volunteer"; Charitable Foundation volunteer movement "Heart of Sevastopol"; Sevastopol Regional Youth Volunteer Public Organization "Team of Life"; Sevastopol regional branch of the All-Russian public movement "Volunteers-doctors"; Regional public organization "Voluntary people's team of the city of Sevastopol"; Sevastopol Fund for Social Support and Health Care "Do Good"; Charitable Foundation "Sevastopol Sail" and others.

Why did I decide to become a volunteer? Probably, the desire to help others grew in me when I saw the injustice of the world. Everyone should make an effort to contribute to better life.

In addition, many of my friends are involved in volunteering. In addition to the pleasant pluses that I mentioned above, it was nice to have something in common with my friends. The educational environment of the university creates all the conditions for a personality forming capable of realizing the skills of helping people who need it as well as a person having empathy – an ability to experience the feelings of another person [7].

How do you know if volunteering is right for you? The first step to this is to find out how aware you are. The impulse to help must come from one's own beliefs and attitudes. You should be aware of your motives and goals for volunteering.

Volunteer code of honor

1. Volunteer activity is aimed at the benefit of other people and brings dialogue and cooperation to society.

2. A volunteer is not entitled to demand encouragement or receive material remuneration equal to or higher than the cost of the work performed.

3. Any person who consciously and disinterestedly makes such a choice has the right to be a volunteer.

4. A volunteer has the right to indicate or not to indicate one's political or religious affiliation, but is not entitled to use volunteer activities to promote one's beliefs.

5. A volunteer gets things done, even if he/she's left alone.

6. The act of a volunteer belongs to all mankind. Tell about it!

7. A volunteer is looking for like-minded people.

8. The activity of a volunteer first contributes to one's personal growth and character forming, and then to the acquisition of skills, knowledge and professional level.

9. A volunteer does not perform work in place of paid workers unless there is a threat to the lives of others.

10. Volunteering must not cause psychological and/or physical harm to the volunteer.

It is important to note that a volunteer is a person with initiative. He/she works without forcing.

You are ready to give your time for free. Being selfless is the most important quality for a volunteer. Personal benefit should not be traced in the actions of a volunteer, since he/she should be more interested in the development of society than in oneself.

In conclusion, it should be emphasize that each of us should try to help others at least. One canbrobably find the matter that you like. the more one volunteers, the more benefits they 'll experience, volunteering doesn't have to involve a long-term commitment or take a huge amount of time out of your day. Giving in even simple ways can help those in need and improve your health and happiness.

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UDC 37.0(092)+13(092)

PHYSICAL EDUCATION IN THE PEDAGOGICAL HERITAGE OF YA.A. COMENIUS

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Аннотация. Рассмотрено физическое воспитание в педагогическом наследии Я.А. Коменского. Именно он пришел к пониманию необходимости целенаправленного физического воспитания. Представлены дидактические принципы Я.А. Коменского, которыми руководствуются образовательные организации.

Ключевые слова: Я.А. Коменский, учитель, здоровье, физическое воспитание, усталость, Материнская школа.

Annotation. The article deals with physical education in the pedagogical heritage of Ya.A. Comenius. It was this scientists who understood the need for targeted physical education. The didactic principles of Ya.A. Comenius, which guide educational organizations are presented.

Keywords: Ya.A. Comenius, teacher, health, physical education, fatigue, Mother's school.

Introduction.Historically physical education has been one of the key pedagogical issues, which is stated by many educators in the pedagogical heritage.Jan Amos Comenius considered didactics as pedagogy. It deals with the issues of teaching, education (mental, moral, physical, and aesthetic), studies and so on [2, 4].Comenius is a humanist of today, in demand not only by Russian didactics, but also by world global political and pedagogical practice.

One of the tasks of the modern education is to find weighty arguments in support of the basic requirement of Comenius's pedagogy, making the achievements of modern science from its most diverse sections accessible to every person motivated to learn.

The didactic principles of Jan Amos Comenius are considered to be basic principle of teaching methods by which all knowledge could be harmonized(table 1).He put forward self-evident principles, some of them full of common sense. The **purpose** of the article is to consider physical education in the pedagogical heritage of Ya.A. Comenius. He wrote pedagogical works, school textbooks, manuals for teachers and parents, and practical activities. W. Hüllen [3], K.Mácha [5] and J.E. Sadler [7] devoted their work to Jan Komensky's methods of teaching.

The main part. Johannes Amos Comenius (Jan Amos Komenský) said that "language was the most important means of education, besides belief and piety" [3, p. 622]. "He favoured the learning of Latin to facilitate the study of European culture" [7].

Learning was considred to become rapid, pleasant, and thorough. A revolution in methods of teaching that time was necessary. "Teachers ought to "follow in the footsteps of nature," meaning that they ought to pay attention to the mind of the child and to the way the student learned" [7, www].

Comenius was sure that there was a better way ofteaching than by the pedanticmethods application. A valuable contribution to the development of humanistic ideas of physical education was made be him as well. "He advocated "nature's way," that is, learning about things and not about grammar" [7]. Jan Amos Komenský made this the theme of The Great Didactic and also of The School of Infancy—a book for mothers on the early years of childhood.

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eternal knowledge and knowledge practically obtained
learning and teaching
nurturing education
saving time
freedom
independence

Table 1. - The didactic principles of Jan Amos Comenius

developing education
learning success
thoroughness of education
ease of learning

In the 19th century Jan Amos Comenius's reputation was revived by the increasing attention given to the study ofpedagogy. Currently he "remains of interest as a prototypeof the international citizen. His patriotic feelings for Bohemia did not prevent him from feeling himself a European and from believing profoundly in the unity of humankind" [7].

"Jan Comenius was born in Moravia, in the town of Nivnice" [1]. His parents were members of the religious community [1].

Ya.A. Comenius paid great attention to forming of physical exercises system. He recognized the need for targeted physical education. In his work "Great Didactics", the issues of raising preschool children and physical training of the younger generation were considered. Comenius suggested that "longer breaks and part of the afternoon should be used by teachers for physical exercises, training and educational work" [1, p.214].

On the basis of the ideas put forward by Comenius, a system of humanistic values and the ethics of physical education was introduced in educational institutions [8], which in a modified form since the second half of the 19th century had an impact on the development of competition standards, now aimed at achieving high results.

In the context of modern problems of education, the ideas of Ya.A. Comenius acquire a special sound. The philosophical and pedagogical ideas of Comenius were not fully implemented in subsequent centuries. His didactics was adapted to the needs of the emerging industrial society. The most important principles were removed – "freely express one's thoughts" and "penetrate the essence of things", corresponding to functional literacy: to read, write, count. Many methods, such as one of morals, continuous education, remained unclaimed.

Comenius stated in the essay "Mother's School" that good health and motor activity are the natural basis for a long and fruitful life ("after all, you won't achieve any success with the sick and frail") and paints how children should be cut "To have a healthy mind in a healthy body" [1, p.218]. In the 7th chapter of the "Mother's School", he emphasized that mother could "bring into the light what she wears under her heart, perfectly developed and healthy" [1, p.219].

A great importance to the system of education and upbringing in society, Comenius saw there the main intellectual link of man, the personality as a rational part of nature. Ya.A. Comenius proceeds from the fact that schools are workshops of humanity, understanding humanity as the resulting complex of creation of a wise, well-behaved and pious person. Ya.A. Comenius notes that schools as institutions for preparing youth for socially useful activities should work hard on the formation of a comprehensive personality.

The humanist proposed using outdoor games and physical exercises in the daily routine of schoolchildren in such a way that they were perceived by the students not as compulsory work under the compulsion of the teacher, but as entertainment and rest from sitting theoretical classes [9].

Comenius' pedagogical system is primarily a Christian teaching, and it is aimed at educating children in the Christian spirit, and later, through appropriately brought up children, it was planned to restore the authority of the church. He wrote that the Lord created two most excellent creations paradise and man. In his scientific work, he relied primarily on the church view, considering it to be the highest goal of his system. He wrote that the longevity of vices and outright evil on earth was rootedin ignorance or in the distortion of knowledge. In some cases, it is the result of objectively poor conditions for education and enlightenment. In others, these are deliberately built mechanisms for distancing people from knowledge.

Conclusion. A valuable contribution to the development of humanistic ideas of physical education was the activity of the largest Slavic thinker and teacher Ya.A. Comenius. Comenius considered the joy of motor activity, expressive mobility of the body, clear order and strict adherence to the established rules, achieving victory not by cunning, but by skill and valor, to be the real decoration of games and competitions.

The didactics of Comenius is based on the universal principle of teaching everyone everything. True success is in this approach, since it ensures the speed of learning and the thoroughness of true knowledge in the field of science and morality, which helps to believe in the possibility of pansophia as a system of genuine knowledge. It is necessary to pay attention to the ideas of Ya.A. Comenius on the importance of educating moral qualities in the unity of reason, feelings and faith.

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UDC 316

GENERAL FEATURES OF MARITIME COMMUNICATION

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Аннотация.В данной статье раскрываются лингвистические и экстралингвистические аспекты профессионально ориентированной коммуникации средствами морского английского языка, выделенные на тшательного основе анализа статей, исследований и работ различные отечественных И зарубежных ученых. Приводятся классификации данного вида коммуникации на основе ее характерных особенностей.

Ключевые слова: профессионально ориентированный, морская коммуникация, признаки, морской английский язык, формы, члены команды

Annotation. This article reveals linguistic and extralinguistic aspects of profession oriented maritime English communication which have been identified due to thourough analysis of theses, projects and work of national and foreign researchers. It includes several classifications and forms of maritime communication developed on basis of its general features.

Key words: profession oriented, maritime communication, features, maritime English, forms, crewmembers.

The interest of national and foreign researchers in linguistic and extralinguistic aspects of profession oriented foreign language communication in general and maritime communication in particular accounts for a necessity to find more effective ways of teaching cadets to maritime English. The latter is used by maritime graduates as a means of profession-oriented communication aimed at cooperating when performing professional duties and resolving professional tasks.

Thephenomenon of "profession-oriented communication" can be defined as information exchange which is carried out by individuals when performing their professional duties or fulfilling tasks of their job description to coordinate joint professional work aimed at achieving the goals set [4, p. 491].

Obvious features of profession-oriented communication include itsinformative value, appeal and motivation for an action as well as impartiality and substantiality. The utterance must be clear for everyone, consequentially it has to meet such requirements as integrity, accuracy and high level of culture [3, p. 12]. Additionally, this type of communication is characterized by purpose orientation and function-and-role based nature, the purpose being coordination of professional interaction, solution of particular problems and communicative professional tasks. Consequently, thistypeofcommunicationservesasa means of organization and optimization of professional work contributing to its efficiency.

The complex nature of profession-oriented communication posed special interest of researchers in profession oriented foreign language communication as in the process of cooperation individuals may experience difficulties caused by both linguistic and extralinguistic factors. The researchers are mostly focused on its psychological features, fundamental problems, guidelines for foreign language teachers instructing students of non-linguistic specialties, psychological and linguo-didactic aspects of profession-oriented foreign language reading, structural components of profession-oriented foreign language listening, profession-oriented writing skills in English.

A general feature of profession-oriented foreign language communication lies in the personal interaction between representatives of different social and cultural backgrounds. Therefore, E.V. Vysokikh came to a conclusion that foreign language communication is predominantly international communication carried out by people of different cultures [2]. Tracing specification of professional cross-cultural communication N.V. Baryshnikov highlights the following definition "Professional cross-cultural communication is a process of predominantly verbal and less nonverbal cooperation of professionally trained specialists" [1].

Maritime communication shares the above-mentioned features of profession-oriented communication and is additionally characterized by the fact that maritime communication among the crewmembers on board merchant ships is carried out by means of the English language which is treated as lingua franca. For a number of reasons English has become the language of the maritime industry. With multilingual crew, mainly coming from the Philippines, India, China, Indonesia, Russia, Poland, Ukraine, etc., it is not speculated that English is the maritime language that facilitates avoiding misunderstanding in maritime communication when sailing with a multilingual crew. Maritime English communication abounds not only between personnel of multilingual crew. It includes verbal ship-to-ship and ship-to-shore cooperation, cooperation during port control, pilotage, mooring operations, etc.

Nowadays, following the implementation of STCW a vessel should not be able to sail without the navigating and senior officers having an adequate knowledge of the English language in order to perform certain tasks and communicate with other vessels. Further, under the STCW regulations, the English language requirements not onlyapply to navigation watchkeepers but also to engineer watchkeepers who are required to demonstrate an ability to interpret engineering publications written in English and cooperate verbally and in written form while performing their duties [11].

The process of maritime communication is characterized by its threefold nature, i.e. it comprises delivering information, interaction and perception. Fairclough believes that there are three analyticallyseparable elements in processes of meaning-making: "the production of the text, the text itself, and the reception of the text" [7, p. 10]. Such a complex nature is caused by the necessity to analyze means, situations, purposes and conditions of maritime communication which may differ greatly from native language communication.

The first component of maritime communication, which is delivering information, includes not only its wording but also clarifying and developing. Providing one of the communicators delivers message to impact his interlocutor, the latter has to decode this message to understand the information contained. The second component, i.e. interaction, engages establishing cooperation which includes knowledge sharing, exchange of ideas and actions. The third component – perception – involves establishing a rapport based on reciprocal understanding. It is to note that these components are interconnected.

Maritime communication is determined by its content and forms and is highly functional. It is used for conveying or exchanging information in the act of navigation, a cargo handling operation, an act of reading operational or maintenance manual for the auxiliary engine, etc in a specific speech community arising and developed under various degrees of stress [10].

Its forms are not constant and unchangeable. They get improved and developed by the interlocutors themselves when maritime personnel interchange their intelligence or language information in the course of their professional activities. Maritime communication, realized both on board and externally, can be carried out as conversation, discussion, negotiations, briefing and may be either spontaneous or planned in advance.

The most common form of maritime communication is a conversation aimed at sharing information, ideas, views on a specific issue leading to cooperation and coordination while solving professional tasks. The conversation efficiency depends on seafarers' professional competency, speaking and listening skills and conversational style. The function of the conversation is to familiarize personnel of the provisions of labour discipline and safe working techniques, to assign duties between crewmembers, to resolve conflicts, etc.

Negotiations as a form of maritime communication are intended at solving tasks which are of mutual interest for all the parties. They have some rules and requirements to be followed and are focused on a joint problem analysis directed at its understanding and solution. This form of Maritime communication is held in three stages: analysis, planning and discussion, the criterion of their efficiency being reaching a reasonable agreement.

Briefings and tool box talks on shipboard are held to increase the crewmembers' awareness of procedures to be followed, to provide skill-sharing, to discuss issues and problems requiring special attention. Briefings are characterized by their responsiveness and constructiveness. They can be featured also as motivative when the participants share their urge, goals and motives.

By its media maritime communication can be classified as direct and indirect. The former is accomplished verbally in the process of speaking. The latter is effected in a written form by means of instruction manuals, letters, written or printed messages, etc. Direct communication supposes personal contact whilst indirect one is conducted via an intermediary [5, p. 45].

Linguistic features of maritime communication are bound with the context of activities performed by maritime personnel in the shipping industry. It makes use of maritime English which is regarded as a restricted language [12, p. 2] developed in response to the society's requirements in the domain of seafaring and shipping [6]. Maritime English does not employ all the means of the English language, it selects only those which may serve the maritime communicative context best. It is to note that linguistically maritime English is not any separate language but just a conventional label for a subset

or realization of English language appropriate to a specific maritime setting used in a determined context of situation arising and being shaped under specific sociolinguistic circumstances.

In terms of grammar and syntax it means, for example, that a restricted and determinable number of general English peculiarities is made use of by Maritime English. On-board and external maritime verbal communication in its discourse may either resemble military-like command speech, e.g. giving order and responding accordingly, orcomposed and performed according to the discourse rules of different dialogue types.

Vocabulary as one of the branches of Maritime English is enriched with the terms for new developments in technical systems of navigation and communication, organization of world shipping, legislation and so on. However, all the newly created terms follow the rules of English word formation. The field of terminology is not the only to be regarded as a specific linguistic feature of maritime communication. Inernationalisms and latinisms are prefered to Germanic and genuine English words, e.g. *I require assistance* instead of *I need help*.

From the phonological and prosodic point maritime communication is characterized by the purposefully reduced speed of speaking, a clearly marked turn-taking in dialogues especially on radio, avoiding contracted forms such as I'll, you're, and many others.

This linguistic limitation, respectively adjustedness expressed in usually consist of routinely-used formulaic structures, conventionalized prosody as well as the restricted vocabulary, is the key presumption for effective communication in the maritime profession [9, p. 112].

Maritime English as a device for communication within the shipping industry is quite flexible in the area of grammar and syntax and highly innovative in the field of terminology, as well as it complies with the rules of the general English languages, e.g. modern dictionaries of maritime terms have been supplemented with the new entries "lidar" and "ladar" created according to "radar" pattern. "Radar" is an acronym of ra(dio) d(etecting) a(nd) r(anging). In case light is used to detect an object, we get lidar; if laser is applied, we call the new means of detecting objects—ladar.

An indisputable requirement for efficient maritime communication is feedback which can be achieved if both parties have the common body of technical and professional knowledge and are able to express it in English. One has to understand an uttered sentence in relation to the situation and environment when and where it has been expressed [8, p. 54].

In spite its numerous specific linguistic and extralinguistic features maritime communication is a natural phenomenon which analysis furnishes maritime, training and academic community with data contributing to developing teaching content, techniques and approaches which can enhance maritime communication training and increase its efficiency.

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UDC81

MARITIME COMMUNICATION TRAINING IN LEADING FOREIGN UNIVERSITIES

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Аннотация. В данной статье рассматривается подход к обучению морских специалистов, в ведущих морских университетах и академиях других стран мира. Целью статьи является анализ изучения принципов и методик, а также способов обучения применяемых в данных заведениях. Проводится анализ подготовки будущих специалистов. Изучается возможность применения данных способов в нашей системе образования. Автор приходит к выводу, что благодаря анализу подхода к обучению других зарубежных морских университетов, становится возможным заимствование и применение отдельных способов подготовки и обучения специалистов в национальных морских университетах страны.

Ключевые слова: английский, образование, учить, методика, подготовка студентов в ведущих зарубежных университетах

Annotation. This article discusses the approach to training marine specialists at leading foreign maritime universities and academies. The purpose of the article is to analyze the study principles and methods, as well as the techniques of teaching used in these universities. An analysis of the training of future specialists is being carried out. The possibility of using these methods in our education system is being studied. The author comes to the conclusion that due to the analysis of the approach to teaching other foreign maritime universities, it becomes possible to integrate and apply certain methods of training and education of specialists in the national maritime universities of the country.

Keywords: English, education, teach, technique, maritime communicationtraininginleadingforeignuniversities.

The importance of English at sea has recently increased considerably as more and more merchant vessels have come to be manned by multilingual crews. Moreover, incompetence in knowledge of the English language can lead to serious consequences, starting with communication problems that can lead to the loss of a ship. The most famous of these situations was the wreck of the ship Costa Concordia in 2012, where one of the reasons was the lack of ratings English commands knowledge, constant repetition of which and asking questions lead to time consuming, eventually cause of the vessel wrecking. This incident served as a serious reason to improve the training of the seafarers for all maritime universities around the world.

Nowadays there is an International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). All maritime universities teach their students in accordance with STCW. This convention also regulates the rules for training and knowledge of the English language. In accordance with the STCW convention, all officers of the watch (navigator's watch or watch in engine room) must be fluent in spoken and written English language. Senior officers with functions at the control level must also speak and write in English, as this requirement relates to the previous level of responsibility. Ordinary seafarers who are part of the navigational watch must be able to perform commands given in English. Crew members assisting passengers in emergencies, must be able to explain themselves to security-related questions in English or in a language spoken by passengers and other staff of the vessel.[7, p.1]

Today, leading maritime universities provide training for students with the help of special methods and techniques. The first of these was Metropolitan College's Maritime Academy in Greece [4, p.1]. Feature of this place is that maritime English is taught by a native speaker who is also an active officer. This technique has many advantages as:

1)Understand Native Accents and Different Voices. Having conversations with native speakers can improve cadets listening skills. Giving them opportunity hear the language spoken in many different voices and accents. Native speakers also often speak at a faster pace, which can be difficult to understand at first if cadets are used to people speaking slowly in a classroom environment. By listening to native English speakers, future seafarers can improve their listening skills and become more comfortable listening to people speak quickly or with different accents.

2)Improve Accent and Pronunciation. One of the best ways to pick up an authentic accent and learn the correct pronunciation of words is by speaking and listening to native speakers. As humans, we naturally mimic the speaking patterns and body language of those we're speaking with. After enough conversations with native speakers, students will start to use the same speaking style as them without even realizing it! 3)Become Familiar with professionalidioms and slang. Practicing with native English speakers also helpscadets learn idioms and slang. Using colloquialisms can help students to integrate with the locals and is an important part of culture. Speaking with natives will also help them learn to use these expressions in theirprofessional maritime communication.

4)Speaking with Native Speakers Forces cadets to speak English. If future mariners speaking with a native English speaker, they will need to express themselves in English. Overcoming this language barrier will help to improve your speaking skills and help them practice English often.

5)Improve Your Confidence in English Classes. Regularly speaking with native speakers will give more confidence. It can be scary at first to speak a new language in front of others, and it's normal to feel nervous about mispronunciations or shy about having an accent. However, once students know that they can express themselves in English and be understood, they will have more confidence in the classroom. Regularly speaking with native speakers will mean that when seafarerwill work in an international crew, they will be better trained to communicate with others.

In maritime communication training some universities from Arabic countries starring Syrian Marine Academy [2, p.2] provide a huge number of various simulators and training facilities all according to the newest technologies in ship machinery, some of them focused on sea work simulation and gaming as a teaching approach. Precise analysis based on the discovery of emersion patterns in the data was used to study the topic understanding of 33 engineering students. These cadets approve experiential learning and reported that learning and having fun brought many benefits on their studying process and overall social life. As well as educators, students became more friendly with the simulators, they developed a better learning effectiveness. Future seafarers complete simulations with awareness of what they have learnt and how they will be developing more.

They also have the two-week simulation-based experience consisted of messaging, essay writing and online conferences. The software was a webbased interface operated by a database client. The project resorted to a webbased questionnaire to measure cadetstraining performance, self-experience and attitudes to simulators. Findings revealed that cadetstraining experienceduring the simulation and they were activated as the simulation invigorated learning. The simulation was a reality in itself and participants responded pleasurably at all times during the simulation period.

Another interesting example in this university where students participated in a computer simulation to learn maritime English. Information was collected via personal interview to learn about trainee opinion of the usage of English languagesimulators. The students perceived that they had learned various aspects related to communication, and this was not hindered by the fact that the simulations were not face to face. Cadets noted that they acquired greatmaritime English-training experience, persuasion and assertiveness in future onboard communication.

I have to mention their study of social cognitive theory, metacognition, and simulation learning identified core principles of intentionality, forethought, self-reactiveness and self-reflectiveness in simulation environments. They asserted that debriefing helps build students confidence and regulation of behaviour. Thus, simulation-based learning combines key elements of cognitive theory and interactive approach to learning. Theorybased facilitation of simulated learning enhances the development of social cognitive processes, metacognition, and self-confidence

Other studies conducted by Syrian Marine Academy in which integrated global simulations get to turn the sea English language classes into its ownsimulated environment. Syrian Marine Academy described a global simulation design as a student-centered, task-based alternative to conventional communication training program for second-year university students of English language classes. Authors provide guides to apply simulations in language courses and identified pluses such as the use of the content knowledge in the simulation dynamics, targeting language activation during collab work. Furthermore, Syrian Marine Academy used simulationbased learning to teach marine English to engineering students. The study impact on future mariners perceptions of how web-based simulations affect the development of theirprofessional language skills. Simulated experience proved to be significant in an engineering studies since a real comprehensive engineering education should provide opportunities to work collaboratively with other professionals in an intercultural setting more than simply solving problems from a textbook.

I have to mention more sides of simulation-based training, Syrian Marine Academy examined perceptions of collab working in web simulatorsvia evaluations of each future mariner portfolio. Students highly valued the collaborative operating required in the simulation, which was reflected by the active participation of all team members and by team members motivation and personal satisfaction. By analysing their teamwork, the students reported that they had become more conistent and had learnt new strategies to communicate with others and solve problems. Students also reported that the collaborative work increased their patience to listening other opinions and to learn from others. All this helped increase their intellectual development and knowledge of the maritime English communication. They also understood specific content faster, improved their language skills and acquired experience in self-assessment.

All above-mentioned techniques and methods bring a huge impact to training future seafarers. Nevertheless some maritime universities seek for

some other media for increasing the efficiency of their cadets' maritime communication training, e.g. Tokyo University of Marine Science and Technology, the biggest Japanese maritime university, provide web learning tools. In a networked learning environment, the student is responsible for actively seeking solutions to problems related to the field of knowledge being studied, with guidance from the teacher. They are expected to see the problems and questions presented by the teacher and other students. Cadets in an online learning environment are also expected to learn collaboratively and cooperatively. Future sailors are expected to work together to achieve a deeper understanding of the course material. Students are also expected to share found resources and other materials with other students. Potential seafarers in a leadership role are expected to participate with minimal guidance, interacting with one another and speaking up when the discussion gets into an uncomfortable zone. Students should be prepared to speak up when they are offended or just have an opinion about something. In general, cadets tend to adopt a more active, motivated, thorough, and self-regulating learning role. This can be an appropriate way to reconsider the role of the teacher and not that of a passive actor. The role of the confident student is a consequence of the less focused role of the facilitator. This increases the students' personal responsibility when learning [3, p.3].

Online learning contributes to developing writing, reading, listening and speaking skills. Reading and listening on the Web are beneficial for students promoting developing their pronunciation, comprehension and enriching their vocabulary.

Online writing provides students with a large number of exercises to practice grammar. Again, assessment is simple as online learners are responsible for their own learning process. They also give students the opportunity to conduct self-assessment. Lecture activity on the Internet is carried out through conferences. The benefits of computer conferencing include remote interaction with other students and the teacher rather than learning alone. A computer conference can be independent of time and distance. In addition, videoconferencing allows cadets to communicate with other peers, mentors; native speakers have the opportunity to compare their pronunciation with that of native speakers. Guest lecturers can be invited to the conference, allowing students to interact directly with experts. Videoconferencing also offers potential seafarers face-to-face communication. A virtual community can be created that offers support and encouragement, promotes exchange among members, and can help overcome the isolation of remote areas.

The use of the Internet for learning the language and web-based education enhances positive attitudes of cadets to maritime communication training. Learning by using the web was quite positive. Increasing
opportunities for cadets on the web could positively influence them. So, teachers use more technological tools in their courses than before.

In some eastern maritime universities, e.g. in Vietnamand China, the maritime communication training system is very interesting, as classesareconducted by two instructors from Europe or America and "his Vietnamese/Chinese assistant, who helps to explain the meaning of words" [5, p.4]. As a result, immersion in the language environment turns out to be almost complete. Students learn Maritime English not only at the university. It is appreciated if cadets master Maritime English and General English individually by watching movies, listening to musical lyrics and reading authentic books.

"India is the second largest English-speaking nation only next to United States" [1, p.4]. Indian officers have done very well in ship operation across the world and they have already made a name for themselves. Indian universities have Content and Language Integrated Learning program. Content and Language Integrated Learning (CLIL)[6, p.4] is an approach where students learn a subject and a second language at the same time. A science course, for example, can be taught to students in English and they will not only learn about science, but they will also gain relevant vocabulary and language skills.

It is important to note that CLIL is not a means of simplifying content or re-learning what students already know in a new language. CLIL courses truly combine language and content to be successful, and success will determine the learning of both the subject and the language. CLIL can work with students of all ages, from entry level to university and up. As long as the course content and language goals are learner-centric, there are no limits on who can benefit from this learning approach. However, it is most common in primary and secondary schools. Many teachers consider CLIL to be a natural way to learn a language; When trying to study a subject in that language, there is a specific reason to study both languages at the same time. And since learners have a real context for learning a language, they are often more motivated to do so as they get the most content just by understanding the language around them. In addition, being content-driven, CLIL teaching adds an extra dimension to the classroom and engages students, which is especially useful in situations where students are not enthusiastic about learning a language. CLIL also promotes a better level of learning as learners constantly encounter similar languages and linguistic features and need to create and remember information in their second language. It also has the advantage that some subjects can be taught in English, which contributes to a better familiarity of students with the language and, thus, language acquisition. CLIL also encourages students to develop 21st century skills, including the ability to think critically, be creative, communicate and collaborate. Having

analyzed various approaches to maritime communication training in leading foreign maritime universities we can subdivide methods, techniques and approaches used into the following groups:

1) simulation-based learning

2) learning with native speaking instructors

3) web-based learning

4) content and language integrated learning

All of above-mentioned approaches can be adopted into maritime communication training in Russian maritime Universities.

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UDC 371

ACTUAL PROBLEMS OF ORGANIZING THE EDUCATIONAL PROCESS IN A MODERN SCHOOL

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Annotation. The article is devoted to the actual problems of the organization of the educational process in the modern school. The main components of education, which are focused on the universal skills of the student, are highlighted.

Keywords: education, educational process, education program, personal development.

Аннотация. Статья проблемам посвящена актуальным организации современной школе. воспитательного процесса в Вылелены основные компоненты воспитания, которые ориентированные на универсальные навыки обучающегося.

Ключевые слова: воспитание, воспитательный процесс, программа воспитания, личностное развитие.

At the present stage of reforming the domestic education system, the state educational policy proclaims education as a priority strategy for the educational system of Russia. And over the past ten years, significant changes have been introduced by the state policy of the country in the field of education.

Thus, the issues of upbringing were included in the new state federal standards of education. Today, the Strategy for the Development of Education in the Russian Federation for the period up to 2025 is being implemented, in which the priority task of education is "the development of a highly moral personality who shares Russian traditional spiritual values, has relevant knowledge and skills, is able to realize his potential in a modern society, ready for a peaceful creation and defense of the Motherland" [2].

In 2015, the all-Russian public and state children's and youth organization "Russian Movement of Schoolchildren" was created, the work of which is designed to increase the effectiveness of patriotic education, the formation of responsibility and respect for the world, and open up new opportunities for self-realization for students [3].

In 2020, the President of the Russian Federation signed the Federal Law "On Amendments to the Federal Law on the Education of Students". "On Education in the Russian Federation", which focuses on a unified system of organization of education in educational institutions, defining the education program as an integral part of general education programs [4].

What changes have been made to the education of students?

Firstly, the very concept of "education" is expanding in accordance with the interpretation of the Strategy for the Development of Education in the Russian Federation.

Secondly, educational organizations of all levels are instructed to provide the maximum solution to the problems of education through: curricula, programs for extracurricular activities and additional education, programs for the educational work of class teachers, and the creation of a developing educational environment.

Thirdly, in accordance with the amendments to the Federal Law "On Education in the Russian Federation", since 2021, the system of organizing educational work has been updated in Russian schools - a new format of the Education Program has been introduced as part of the education program.

Such changes in the education program affected the goals, conditions, forms of implementation of the educational process and its management in an educational organization:

1) the new format of the education program defines the personal development of students as a single goal of education in all educational organizations, which can be ensured: in the assimilation of socially significant knowledge by them, the development of their socially significant relations, the acquisition of experience in the implementation of socially significant deeds;

2) the new goals of education are aimed at familiarization with national basic values and are defined as the main moral values, priority moral attitudes that exist in the cultural, family, socio-historical, religious traditions of the multinational people of the Russian Federation, transmitted from generation to generation and ensuring successful development;

3) upbringing is considered not as a "pedagogical influence" on the personality of the educated person, but as a kind of pedagogical interaction with it, i.e. in education, subject-subject relations receive priority;

4) the main focus of education remains the national educational national ideal - a highly moral, creative, competent citizen of Russia, who accepts the fate of the Fatherland as his own, aware of the responsibility for the present and future of his country, rooted in the spiritual and cultural traditions of the multinational people of the Russian Federation, justified taking into account the changed educational situations;

5) education is recognized as the leading priority in the universities;

6) the expected results of the Federal State Educational Standard, such as subject, meta-subject and personal in the "Exemplary program of education of students" can only be obtained in the process of updated content of education, adjusted for new goals and guidelines [1].

It is impossible to give an unequivocal answer to the question: how to raise children, too many factors and life circumstances influence the choice of the only correct decision, which predetermines the further successful development of the personality of a growing person. But, building a strategy for modern education, it is necessary to take into account a number of external and internal factors. Global tasks are set before the pedagogical community [6].

The main components of the transformation of education focused on the universal skills of the student, first of all:

1) to teach students to solve problems and make decisions through the development of critical and creative thinking, which is possible through joint collective, creative activity in cooperation and interaction;

2) to cultivate a communicative culture through the development of emotional intelligence, a culture of thinking and speech in active communication, events of inter-age interaction, mastering the virtual educational space;

3) to cultivate a civic position, responsibility to oneself and others, dedication to self-determination and self-realization through project, research, volunteer activities [5].

Since the beginning of the XXI century. Almost all changes in educational work at school are associated with the development of new or adjustment of traditional approaches and technologies:

So, the main educational result of school education is the formation of the key competencies of the student, due to the experience of his activities in a certain socially and personally significant area.

- there was a replacement of the essence of the educational ideal from socially-oriented to personality-oriented;

- new educational technologies take their place and are implemented next to the traditional ones;

- Today, the idea of raising a successful person of the 21st century with universal communication skills, critical and creative thinking, teamwork and cooperation has received wide recognition;

- in almost all education programs, they found a place of orientation towards the education of the personal qualities of a person of the future: initiative, curiosity, perseverance, adaptability, leadership, global literacy;

- in the content of education, targeted programs and projects turned out to be in demand, opening up opportunities for self-actualization and selfrealization of the personal potential of students, including them in transformative activities;

- an actual aspect of education at school is the preparation of schoolchildren for life in a multi-ethnic, multicultural world [5].

And modern society is already difficult to imagine without information technology, therefore, the direction of educating students in networking, multimedia space of the school, in a virtual space is actively developing. The power of the media is so great that they are called the "parallel school"

Thus, the organization of the educational process in a modern school is based on the search for new ways to solve the problems of education in modern society, which should be carried out in the context of ongoing changes, taking into account life realities, trends in social and sociocultural development, and the characteristics of modern children and youth.

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UDC 614/31.02/614.8 SITUATIONAL TASKS IN THE COURSE "LIFE SAFETY"

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Аннотация. Статья посвящена рассмотрению ситуационных задач в курсе безопасности жизнедеятельности в вузе. Раскрыты типы ситуационных задач в области пожарной безопасности и оценки чрезвычайных ситуаций. Представлены примеры ситуационных задач в контексте формирования ноксологической культуры будущих специалистов. Даны практические рекомендации по оптимизации преподавания дисциплины «Безопасность жизнедеятельности».

Ключевые слова: ситуационные задачи, студенты вуза, безопасность жизнедеятельности, ноксологическая культура.

Annotation. The article is devoted to the consideration of situational tasks in the course of life safety at the university. The types of situational tasks in the field of fire safety and assessment of emergency situations are disclosed. Examples of situational tasks are presented in the context of the formation of a noxological culture of future specialists. Practical recommendations for optimizing the teaching of the subject "Life Safety" are given.

Key words: situational tasks, university students, life safety, noxological culture.

Introduction.The subject"Life Safety" is the basic one of the curriculum for bachelors preparation. The knowledge gained as a result of studying this subject is in demand not only when students undergo educational and industrial practices, but also in independent production and household activities.

It should be noted preventive, knowledge in the field of safety, in connection with which the urgent task of scientists and teachers in this area is to transmit knowledge about the patterns of occurrence and development of dangers, the formation of practical skills in students for their optimal elimination and prevention. Such an convertion of the system-activity approach in the practice of higher education makes it possible to form a noxological culture (safety culture) among future specialists [1, 7]. The **purpose** of the article is do describe the situational tasks in the course of life safety at the university.

Main part.In such a field of knowledge as life safety, it is absolutely not enough to be limited to the traditional forms and methods of teaching and research for higher education [11].

We recommend to use situational and creative assignments in teaching along with traditional tests for self-control and assignments for essays, which allow to motivate students, bring them closer to the problem under consideration, and also give you the opportunity to "feel for yourself" an extreme or emergency situation [11].

The purpose of mastering the subject"Life Safety" at the university is the formation of a professional culture of safety (noxological culture). Noxological culture is understood as the readiness and ability of an individual to use the acquired body of knowledge, skills and abilities in their professional activities to ensure security. An actual aspect of noxological culture is the formation of such a nature of thinking and value orientations, in which security issues are considered as a priority [4].

The issues of noxology in the context of noxological culture are covered in the educational literature by such authors as E.F. Baranov, M.N. Misyuk, E.I. Kholostova and others [1, 5, 9]. At the same time, teachers of the subject "Life Safety" strive to update the most significant issues of the formation of noxological culture among university students, especially in connection with the regional binding.

The objectives of teaching the subject "Life Safety" are:

- acquiring an understanding of the problems of sustainable development, ensuring life safety and reducing the risks associated with human activities;

- mastering the methods of rationalization of life, focused on reducing the anthropogenic impact on the natural environment and ensuring the safety of the individual and society [6];

- formation of a culture of safety, environmental awareness and riskbased thinking [8];

- formation of a culture of professional safety, the ability to identify hazards and assess risks in the field of their professional activities, as well as a reasoned justification of their decisions from the point of view of safety

One should consider some situational tasks in relation to fire safety, built on an elementary algorithm of actions. Fire safety is a kind of "classic of the genre" due to the fact that many extreme and emergency situations are accompanied by fires [9].

Situational task "Fire in the kitchen"

Procedure: cover the dishes with a lid, remove from heat. It is recommended to have a fire extinguisher at home.

Situational task "Combustion of a household appliance"

Procedure: pull out the plug from the socket, and if the fire has not stopped, cover the place of fire with a coverlet made of natural fabric or fill it with water. It is recommended to have a fire extinguisher at home [5, p.52].

The subject"Life Safety" is the basic discipline of the curriculum for the preparation of bachelors. Its study is based on the knowledge gained in the study of the disciplines of the humanitarian, social, and natural science cycles of the school educational program. The knowledge gained as a result of studying this discipline will be in demand in the future when students undergo educational and industrial practices [7].

The problem of fire safety in 'Life safety' course should not be limited to domestic or industrial situations. It is necessary to connect the regional and ecological context [2, 3,4]. Thus, the problem of fires in the Crimean forests due to the fault of irresponsible tourists is increasingly attracting attention.

This is due to the fact that for the Crimean natural and climatic conditions, enhanced fire extinguishing is necessary. Extinguishing by covering with earth or trampling is insufficient.

This is due to the fact that for the Crimean natural and climatic conditions, enhanced fire extinguishing is necessary. Extinguishing by covering with earth or trampling is insufficient. It is necessary to fill the fire with much water in order to avoid smoldering processes. This is all the more important in the face of the threat of a decrease in bioland scape diversity in the Crimea. We called this situational task "A bucket of water for a fire".

Situational task "A bucket of water for a fire".

Procedure: being in nature, quench the fire with waterequal to the volume of a bucket (10-12 liters).

The presented situational tasks with the connection of algorithmic thinking allow fixing in the minds of students a clear plan of action in extreme conditions.

Most of the topicts of "Life Safety" is made up of practical exercises, which is associated with its practice-oriented orientation. Each lesson should be subordinated to the general goal - the formation of a noxological culture of students. One should dwell on the main aspects of the implementation of this goal in the educational process. First of all, it is the preventive nature of knowledge in the field of life safety, i.e. warn of dangers and protect against them. The task of the teacher here is to provide knowledge about the general patterns of occurrence and development of hazards in emergency situations, the formation of the skills necessary in the practical activities of any specialist to eliminate and prevent hazards.

Man is the object of study of anthropology, medicine, psychology, sociology and other sciences. The environment is studied by astronomy, geography, geology, biology, ecology, etc. In turn, the subject"Life Safety" in the educational field is the scientific and methodological foundation for other disciplines on safety (ecology, social ecology, labor protection, communal hygiene, occupational health, fire safety, civil defense, etc.) [10].

In our opinion, situational tasks of an emergency nature, aimed at assessment and self-assessment, in which a student can become a kind of participant or expert, are no less relevant from the standpoint of a systemactivity approach in the field of life safety. Such situational tasks should no longer be distinguished by simplicity, as in fire safety, but, on the contrary, should reflect a multifaceted and multifactorial reality. In this sense, situational tasks become cases.bOne should give some examples of emergency situational tasks-cases.

Situational task for assessing emergencies

Evaluate this emergency according to three signs (classifications) of the cause of occurrence, temporal characteristics, scale and severity of consequences. In winter, at an air temperature of -25 degrees, as a result of an accident on a heating main, two residential buildings, in which about a hundred people lived, were left without hot water and heating. It was not possible to quickly eliminate the accident. It took four days to restore the heating network. Many residents moved in with relatives, some settled in the school building, Some people stayed in their apartments. There were no

casualties, but material damage was caused to the property of citizens [5, p.23].

Situational task "Accident with the release of hazardous chemicals"

In the area of the Chervishevsky tract there was a smell of rotten hay or rotten fruit. Four hours later, people felt itching and burning in the rhinopharynx, as well as a sweetish unpleasant aftertaste in the mouth and nausea.

You should "determine from which substance the poisoning occurred, what are its possible sources and imagine the procedure" [5, p.39].

The next aspect of the formation of noxological culture of students is related to the fact that the subject"Life Safety" is a multifaceted object of understanding and perception of reality, which requires the integration of various fields of knowledge. These include sciences that consider various facets of security:

1. Humanitarian (philosophy, theology, linguistics);

2. Natural (mathematics, physics, chemistry, biology, ecology);

3. Engineering (strength of materials, engineering, electronics);

4. Human sciences (medicine, psychology, ergonomics, pedagogy);

5. Social sciences (sociology, economics, law).

It can be concluded that this kind of situational tasks-cases for assessing emergencies by students not only contribute to the application of their knowledge in practice, but also carry an educational aim, developing in them feelings of empathy and mutual assistance, which is important in the formation of noxological culture [12].

And, finally, the important aspect of the formation of noxological culture of university students is its close connection with ecological culture. It is impossible to study the characteristics of a person, group or society without taking into account their place in the environment and the state of this natural or anthropogenic environment.

The subject"Life Safety" studies the system "man – environment", in which a person is a subject - a carrier of subject-practical activity and cognition, a source of activity aimed at an object - the environment. And such constructive human activity must be, of course, environmentally friendly. Therefore, it is so important for the teacher not to separate the noxological culture from the ecological one and to rely on the regional context in the educational process [2-4].

Conclusion. Thus, situational tasks in the field of life safety allow solving a whole range of research and educational tasks, as well as instilling in future specialists the stereotype of rational life and noxological culture. Thus, the leading goal of studying the subject"Life Safety" at the university is the formation of a noxological culture among students through the development of preventive knowledge and skills in relation to dangers,

the implementation of broad interdisciplinary connections and reliance on the ecological picture of the world of students in the regional context.

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SPORTS TOURISM FOR AUTISTIC CHILDREN

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Аннотация. Автором предложена собственная методика по физическому развитию с помощью специальных упражнений, которые оказывают лечебное действие. Отмечено, что мышечная деятельность – этоглавный фактор, изменяющий функционирование внутренних органов. Даны рекомендации по спортивному туризму как активности, которая не только гармонично развивает личность, но и носит важный прикладной характер.

Ключевые слова: дети с ограниченными возможностями здоровья, расстройство аутистического спектра, физические упражнения.

Annotation. The author proposes her own methodology for physical development by means of special exercises that have a therapeutic effect. It is noted that muscle activity is a main factor that changes the functioning of internal organs. Recommendations are given on sports tourism as an activity that not only harmoniously develops the personality, but also has an important applied character.

Keywords: children with disabilities, autism spectrum disorder, exercise.

It is estimated by World Health Organization that about 1 in 100 children has autism [6]. Autism spectrum disorder (ASD) is considered to be "a developmental disability caused by differences in the brain. People with ASD often have problems with social communication and interaction, and restricted or repetitive behaviors or interests" [10].

Autism spectrum disorder (ASD) is a group of mental ones that are characterized by impairments in social interaction and communication - the process of communicating and transmitting information to other people."Care for people with autism needs to be accompanied by actions at community and societal levels for greater accessibility, inclusivity and support"[5]. Autistic children are very closed, not sociable, they live in their own world, breaking away from reality. It is important to note that autistic people very often lose interest in reality and communication with other people. They often demand that all their fantasies and desires come true. And also they often do things that go beyond logic [4].

Autistic children have special problems in the field of sports and physical development, because of this they are not physically developed and socially isolated. They may also have different ways of moving, learning or paying attention. Some children withoutASD might also have some of these symptoms. But for people with ASD, these characteristics can make life very challenging [3].

According to the research of Russian scientists (R.R. Magomedov, E.F. Torikova [2], T.V. Vishnevetskaya, I.A. Dotsenko, N.V. Smekhova [2]) as well as foreign ones D. Nader, B. Dunlop, B.Tomaszewski, A.M. Sam, K. Hume, M.Aljuaid, S.L. Odom [9]) physical exercises have a therapeutic effect, since muscle activity is the main factor that changes the functioning of internal organs. The Social Skills Improvement System Rating Scales (SSIS-RS) is a widely used social skills assessment for autistic children. S.Lewis, N. Papadopoulos, A. Mantilla, H. Hiscock, M. Whelan, J. McGillivray, N. Rinehart proved that up to 80% of children with autism experience behavioural problems and shorter duration, which are associated with increased autistic symptom expression and emotional difficulties [7]. The purpose of the article is to describe author's methodology for physical development by means of special exercises that have a therapeutic effect.

The formation of a sense of satisfaction from physical activities optimizes the motor mode, increases efficiency and stabilizes emotions. A child with developmental disabilities cannot form a physically active lifestyle, because. it is much more difficult for him than for healthy peers to perform movements and he has less opportunity to get joy and pleasure from movements. Hypokinesia leads to neuropsychiatric disorders (memory weakens, interests narrow, speech function is disturbed), asthenization of the body develops, and pathological changes in the neuromuscular apparatus increase. Asthéneia is a painful condition manifested by increased fatigue and exhaustion with extreme mood instability, weakening of self-control, impatience, restlessness, sleep disturbance, loss of the ability for prolonged mental and physical stress, intolerance [8].

During training, it is very difficult for children to make them perform

certain exercises, they are simply not interested in this activity. Therefore, it is very important to interest the child. For this, it is necessary to approach the classes in a playful way [8].

Sports tourism is an activity that not only harmoniously develops a person, but also has an important applied manner. In addition to physical stamina, tourism has a positive effect on spatial and logical thinking, contributes to the formation of healthy eco-habits and a responsible attitude towards the environment. Being outdoors plays an important role in human health and prevention of viral infections.

From small to big:

-The first step is to introduce the child to the equipment.

-Learn to put on the system

-To do this, you need to show with an example so that the child understands what it is for.

-Next, one need to put the system on the child, then take it off and ask to put the system on yourself.

-After that, oneshould move on to carbines!

Carabiners are different, carabiners with a twisted clutch are best suited so that the child would be interested in twisting and opening the carabiner himself. This is very good for developing fine motor skills.

It is difficult for children with autism to complete stages that require logic and great physical effort. Therefore, simple stages that will train their physical abilities are suitable for a start, such stages as:

1. Passage of the traverse stage - work with re-stitching of carabiners, develops logic!

2. Stages "Climbing the slope using a jumar".

3. Stages "Descent down the slope using descenders".

4. Hinged crossing-rope stretched between two trees or other fasteners 5. Stage parallel rope etc.

Conclusion. Thus, when passing through mentioned by the author stages, the child becomes interested, because this is not a game of football or hockey, which require more mental abilities and one need to analyze and make decisions quickly, but it is very difficult for children with autism. And they really like to hang and swing on a rope, because it resembles a swing , but at the same time they climb the rope and make efforts, thereby training stamina.

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THE PROCESS OF SELF – STUDY ORGATIZATION OF ENGLISH LEARNING BY FUTURE MARINERS

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Аннотация.В статье рассматривается самостоятельная работа курсантов высших морских учебных заведений, предоставлены средства организации самостоятельной работы для овладения морским английским языком будущими судоводителями И судовыми механиками. Дается четкое определение термину «самостоятельная работа». Установлено, что самостоятельная работа курсантов - это спенифический вид обучения. Выделяют основные виды самостоятельной работы: делается акцент на определении уровня формирования самостоятельности, который позволяет преподавателю организовывать самостоятельную работу курсантов более эффективно.

Ключевые слова: морскойанглийский язык, курсанты, самостоятельная работа, мотивация, рейс.

Annotation. The paper studies the self – study of cadets of maritime higher educational institutions, the means of organizing self – study for mastering maritime English by future navigators and marine engineers are provided. Clear definition is given to the term "self - study". It is defined that self – study is a specific type of learning. The main types of self – study are distinguished; due attention is given to the level of self- study formation which allows the teacher to organize self – study of cadets more effectively.

Keywords: maritime English, cadets, self –study, motivation, voyage.

Modern conditions of globalization of all economic activity areas and the rapid pace of information creation require active and competent specialists of marine industry. Thus, the main task of higher education is the formation of creative personality of future navigator or marine engineer who is able to self-development and self-study of innovation practices.

The rapid development pace of international fleet as well as a large flow of information which must be received and used requires constant training. The long–life learning ensures effective performance of professional duties. The rethinking of cadet's self-sufficiency degree in the educational process occurs and the importance of self – study during vocational training increases.

There is the necessity to change the approaches to the organization of self-study and increase skills development of self-study that improves the quality training in such a way that theoretical and handling competence of

specialist meets the requirements of graduating students and give an opportunity to compete in the international labour market.

Solving of these problems is impossible without drawing attention to the cadets' self- study, teacher's responsibility for the skills development of self –study, stimulating the professional development of cadets and their creative activity and initiative.

Special attention is given to the self – study as a way of professional growth of future specialists in maritime higher educational institutions. It doesn't mean only activation of cadets' abilities that teach them to scientific research by means of English language. Such training method has professional importance during shipboard training which is usually a very long voyage. Due to this method cadets learn how to carry out information search and choose from the obtained information the most significant one, evaluate it and take part in professional discussions.

Many scientists have studied the organization of the cadet's self- study for mastering English language. The most famous of them are O.S. Kovalchuk , A. N. Kotlovskiy , O. V. Parfonova, O. P. Bykonia, I.P. Zadorozhna. Moreover, only some scientists draw their attention to the organization specify of self – study by the cadets of maritime higher educational institutions. Thus, it is obviously that it is necessary to continue further investigation in this direction.

The aim of the paper is to study major aspects connected with the self – study organization for mastering English language by future navigators and marine engineers.

There is much concern about the problem of self – study organization of cadets of maritime higher educational institutions because the traditional methods which become obsolete due to wide use of digital techniques in up – to – date education.

Knowledge of English language is essential to mariners. International Convention on Standards of Training, Certification and Watchkeeping, (STCW 1978) define required English level for carrying out the duties by every crewmember [3]. The result of mastering language can be shown by the following competences: communication skills which are used orally and in written forms in English for solving such problems as professional, interpersonal and intercultural collaboration according to which the level of proficiency in English is not lower that colloquial.

As a rule the self- study of cadets of maritime higher educational institutions is an integral part of the present educational process. There are following conditions for the efficiency improvement of cadets' self – study [2]:

-the updating of learning and teaching documentation, development of new didactic approaches for intensive self- study;

-the optimization of teaching methods, introduction of innovative technologies increasing the teacher's labour productivity, extensive use of digital technologies that allow our cadets to study the material during long voyages at a convenient time;

- clear planning of the cadet's self –study: defining the aims, subject matter and terms of carrying out self –study which should comply with competence formation;

-the period of time assigned for the cadet's self- study should be recorded in the working program of the discipline and based on the standards which are given for performing all the types of self – study tasks in the discipline "Foreign language. English language".

The cadet's self-study can be classified as a type of learning that has the same structure as learning activity: aim, motive, method, result, process, subject and conditions. During self – study the cadet's self – change occurs due to individual determination of purpose, planning, regulation and activity assessment, activation of personal motivation, practical learning as well as due to the cadet's changes because he becomes more active and initiative. Cadets carrying out the tasks of self – study become a party in charge of an activity and are ready for self – development of their capabilities by means of English language. Cadet's self – development occurs due to carrying out of self- study and mastering key competences in English. Thus, self –study is a source of development and self- development of cadet's personality.

O. Bikonya distinguishes the following special features of cadets' selfstudy in English:

- the creation of linguistic environment that means the combination of English language activity and cognitive activity of cadets;

- the development of all types of English language activity (listening, speaking, reading and writing);

- the activation of all types of memory;

- the self – study management based on the individual characteristics of every cadet[7].

I. P. Zadorozhnaya identifies four types of self – study in English:

- self – study with verbal means such as introduction of language material and its study with the aim of further use in productive activity;

- self – study training work with linguistic means such as carrying out of different exercises and tasks of various communicative orientation. For example, there are such types of works as: formation of language units bank; carrying out of traditional exercises; text transformation; brief description of the given text or drawing up of your own texts; correction; compilation of speech exercises for group mates; translation of the text using your own linguistic means;

- self – study with English text;

- self-facilitated speech practice based on the types of English communication. They are self-facilitated reading, listening, and correspondence.

Due to the English language peculiarities it is possible to determine the following components of self – study of cadets at the higher educational institutions:

-the motivation block (why should self- study in English be carried out regularly?);

-the lingvo –communicative block (What learning material is the most suitable for self– study in English?);

-the organization block (With the help of what should self – study in English be organized?);

-the professional and applied block (where will gained professional knowledge, skills and abilities be applied by graduates?) [8].

Let's consider the cadet's self – study. The motivational block includes needs and motives. Motivation is expressed in persuasive a person to action, in mobilization of internal energy which is connected with further actions. The subject of the activity of the person being taught is various actions (mental, speech) which are performed during self –study. They depend on motivation formation level. Motivation determines person's behavior in self – study.

Motivation also includes need in learning, learning motives, aim, emotions, attitude and interest. At the same time motivation is closely connected with cadet's needs and interests at different levels of education. Motivation is a complex system of various types of human attitude to reality, himself or another person.

Some scientists consider motivation as complex process which is the result of self-awareness of past activity in new conditions. That's why students who are capable for adaptation have motivation to learning.

Thus, motivation includes several components such needs, aims, motives and self- awareness. All these components form motivational structure of learning. The most important of them are learning motives it means that the degree of cadet's self – study depends on the cadet's realizing the value of education.

The lingvo- communicative block includes means for cadet's self – study. They are didactic materials, lexico – grammatical exercises, texts for self-study, before reading and after –reading exercises, textbooks, learning guides and electronic learning resources.

The organization block shows the place, time period, cadets' actions (speech, mental), forms of self - study (individual, group) as well as pedagogical conditions for the implementation of such work.

The professional and applied block means the branch of engineering sciences where future navigators and marine engineers will use their knowledge gained as a result of mastering English language.

The types of tasks for cadet's self- study can be classified depending on the self – study level as follows: reproductive, semi-educational, creative [6].

The reproductive level includes the exercises aimed at correct and accurate cadets' perception; exercises which exclude unnecessary concept; tasks aimed at identifying general linguistic and cultural awareness.

Semi – creative level includes exercises aimed at providing correct localization of new words regarding to words of native language; exercises aimed at ensuring the correct and various combination of new words with already known ones; listening or reading including compositional analysis of the text; making up the multiple choice tests by cadets using linguistic and cultural information.

Creative level includes writing a letter on discussed problem, disputing tasks, exercises such as "sentence fragment", business games, tasks where educational web- quests are used, tasks using techniques which are closely connected with their future profession.

Due to analysis and collation of theoretical provisions, we can clarify the definition of the term cadets' self- study. This term means specific type of education which is characterizes by the ability to set objectives plan and perform certain activities, ability to reflect and create a personal educational product based on subjective foreign language experience.

Also based on personal experience we can distinguish the following classification of self – study in English:

1) the reproductive self – study includes carrying out of various grammar and lexical exercises as well as comprehension exercises connected with text content. These exercises are aimed at mastering speech material. The reproduction and understanding of grammar constructions and lexical units occur at this stage.

When studying foreign languages the reproductive self – study includes carrying out speech (training) exercises: grammar and lexical exercises; creative exercises (performing matching tasks, filling in gaps, translation, quiz, crosswords, sequence restoration, text reconstruction, multiple choice questions, questions with mixed type of answers, questions with a short answer, questions with an alternative answer).

2) the heuristic self – study means performing not only grammar and lexical exercises to the text but also exercises for further understanding studied material (texts) and creative activity. When studying English this type of cadets' self – study includes translation, retelling, annotating, texts summarizing, description, relation expression and evaluation. This type of work also includes online searching and carrying out tasks for text

comprehension, creating different projects by means of Power Point Presentation and etc.

3) the creative (research) self – study is the third and final stage of mental activity. Creative self – studies include linguistic exercises while studying English. The cadets' activity has search and creative character, it is not connected with lexical and grammar exercises. The cadets develop and offer their own solutions to the problem situations, analytic and research Web – quests. This type of cadets' self –study is aimed at the development of creative (research) capabilities. At this level cadets demonstrate the formation of mental independence.

It should be noted that reproductive activity prevails in the first type of self – study, in the second type the correlation of reproductive and productive tasks consists of 50 %, in the third type creative activity prevails during which the cadets work on projects and create information projects in English.

In general the teacher cannot form directly cadet's personal autonomy. The teacher's task is to create conditions for cadets' self- study that provide the education of cadets as initiative persons who are ready for achieving goals, management and correction of their educational process and self-realization of their cognitive, organizational and practical abilities using modern technologies. On the part of the teacher the essence of education and training is concluded in stimulation of cadets' self – study.

It is advisable to systematize the work on self – study organization of maritime English language among future specialists of the maritime industry in the form of a pedagogical pattern. The pedagogical pattern consists of three types of activity. This model is based on linguistic activity which also has three stages: 1) motivational stage that is realized by complex interaction of needs, motives and future result; 2) analytico-synthetical stage involves the selection of means for carrying out the activity; 3) the stage of implementation, where the activity occurs [2].

The purpose of motivational stage is the mastering of linguistic knowledge, the development of speech competence as well as the readiness for use of information technologies and educational strategies while planning cadets' self – study. Aims, principles and tasks are implemented in the content of self – study based on IT – technologies. The cadets' self – study is aimed at structuring of this work. According to person-centered approach, self – study is a two –subject process in which the teacher and the cadet are the subjects of educational activity.

One of the most important tasks which are necessary for effective cadets' self – study is teamwork. Such type of activity is essential during their shipboard training or voyages. The principle directions of cadets' teamwork in self –study can be the following:

- the training group is divided into two teams to solve specific training tasks;

- every team receives a specific task and performs it jointly under the direct supervision of the team leader;

- the tasks are performed in such a way to take into account and evaluate the individual contribution of each member of the team.

The teamwork is based on cooperation and mutual assistance, ensures the participation of all cadets in self – study, shows their individual characteristics and provides the development of personal qualities.

The most advances methods can be methods aimed at cooperation, eportfolio, reproductive and productive exercises used in reading. These methods provide cadet's active participation in the educational process, subject – subject relationship between the cadets and the teacher, use of information technologies in the learning process, different communication modes and forms of control. At the same time the priority form of interaction is given to "cadet – cadet" and "cadet – information technologies".

The purpose of the final stage is implementation of self – study skills by means of reading in English. This stage solves the following tasks such as formation of communicative competence; formation of information competence, implementation of academic competence.

The basic condition of cadet's self – study is its productive character. The self – study is aimed at cadets' educational result.

The level of self – study can be defined by the number of criteria: a set of knowledge, skills and experience; the list of competences which the cadet has and which allows him to continue self – study with the help of English language.

Knowledge, skills and experience can be considered as criteria on the basis of which the formation of cadets' self – study is defined.

Thus, the following theoretical positions were defined when considering the cadets' self- study problem:

- the cadets' self –study is a specific type of learning which is characterized by the ability to set a goal and carry out certain activities, the ability to reflect and create a personal educational product based on foreign language experience;

- the cadets' self – study is aimed at the formation of cadets' of cadets' self-sufficiency;

- the cadets' self – study is divided into three types. They are reproductive self – study, heuristic self – study and creative (research) self – study.

The level of self- study formation allows the teacher to organize self – study of cadets more effectively and it is cadet – oriented. The proposed sequence of organization of cadets' self – study is intended to gradually form

cadets' independence. The organization of educational process using modern distant learning technologies can be as the directions for further research.

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UDC 372.8

CREATIVE ACTIVITIES OF STUDENTS IN THE COURSE OF STUDING SOCIAL SCIENCE

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2nd year undergraduate student, Natalia Kovaleva, associate professor, candidate of pedagogical sciences, Humanitarian and Pedagogical Institute, Sevastopol State University E-mail: nskovaleva26@mail.ru Аннотация. Статья посвящена анализу творческая деятельности обучающихся на уроках обществознания. Выделены основные процессуальные черты творческой деятельности, функции и формы. Дана характеристика учебно-познавательного творчества

Ключевые слова: творчество, творческая деятельность, обучение, познавательная деятельность.

Annotation. The article is devoted to the analysis of the creative activity of students in the lessons of social science. The main procedural features of creative activity, functions and forms are singled out. The characteristic of educational and cognitive creativity is given.

Keywords: creativity, creative activity, learning, cognitive activity.

The study of creative activity in the course of studying the course of social science is based on the approval of the active creative and cognitive activity of students as the leading condition for increasing the effectiveness of teaching the subject.

The subject of creative activity of students in the domestic pedagogical literature is covered quite widely. In the works of scientists-teachers, the pedagogical foundations of the creative educational and cognitive activity of schoolchildren are considered (I.Ya. Lerner, A.P. Tryapitsyna, A.V. Khutorskoy, G.I. Shchukin), the process of developing creative activity and independence is described (P. I. Pidkasisty, B.P. Esipov, N.A. Polovnikova,), the activity of creativity is studied (M.N. Skatkin, M.I. Makhmutov, T.I. Shamova), the issues of individualization and differentiation of the process of development of creative activity are considered (A.A. Kirsanov, J.E. Unt).

Researchers I.V. Sakhnova and L.P. Ermilov defined creative activity as an activity in which creativity, as a dominant component, is included in the structure of either its goals or methods [3].

I. Ya. Lerner, defined creativity as a form of student activity aimed at creating objectively and subjectively "new values for him that have social significance, i.e. important for the formation of personality as a social subject" [1, p.51-52].

In scientific works I. Ya. Lerner identifies such procedural features of creative activity as: independent, intra-system and inter-system transfer of knowledge and skills to a new situation; vision of a new problem in a traditional situation; vision of a new function of the object in contrast to the traditional one; "vision of the structure of the object; taking into account alternatives in solving problems; combining and transforming previously known methods of activity in solving a new problem; discarding everything known and creating a fundamentally new way of explaining" [1, p.51-52].

Creativity is always carried out on a specific material and therefore is inevitably embodied in a structured educational material. Such a form of structuring the latter is a problematic cognitive or practical task [9].

Problem-based learning has three special functions: the development of creative learning skills (the use of logical techniques or individual methods of creative activity); fostering the skills of creative application of knowledge (application of acquired knowledge in a new situation); formation of skills of creative activity (mastering the methods of scientific research). Thus, the learning process should be defined, among other things, as a process of mastering the experience of creative activity. Learning, in which students are systematically involved in the process of solving problems and problematic tasks built on the content of the program material, is problem learning.

The inseparable connection between developmental learning and creative activity has become the main content line in the work of L. N. Kortunov, which presents an interesting attempt to trace the dynamics of research on problem-based learning and the development of students' creativity, from the origins of the scientific substantiation of the topic to the prospects for its development. The author, having outlined the theoretical foundations of problem-based learning in his work, defined problem-based learning as a special type of learning, the characteristic feature of which is its developing function in relation to creative abilities. This type of training is a didactic system based on a certain understanding of the logical and psychological patterns of the development of thinking and creative abilities in general [5]. The system of problem-based learning should become a program of education and upbringing, which will make it possible to turn it into a program for the development of the child.

In modern works on pedagogy, an approach to a fairly broad understanding of creativity is retained. At the same time, it is possible to include in the concept of creativity not only in educational activities, but also technical, artistic and other forms of manifestation of the student's creativity [6]. There are different levels of creativity:

- practical or applied creativity (a tendency to solve narrow and applied problems, passivity when working with theoretical material);

- "directed" creativity (with interest and success they can work in different directions, but show the ability for "theoretical" creativity with the support of a teacher);

- "professional" creativity (typical for a small group of students who are prone to independent long-term work, while the teacher in the area chosen for in-depth study is more likely to play the role of a consultant) [8].

The creativity of a student is similar to the creativity of a scientist, an artist, by the very mechanism of discovery. The creativity of schoolchildren is subjectively new in nature, although the objective novelty of the result is

not ruled out, especially at senior school age. As a result of creativity, the student creates qualitatively new values "for oneself", while the result of the activity can also be regarded as having social significance, since it is important for the formation of the individual as a social subject [2].

In didactics, the study of creative tasks as an independent phenomenon in the pedagogical process has been developed. So, the only possible way to transfer the experience of creative activity I. Ya. Lerner considers pedagogical constructions in the form of creative tasks built by the teacher, in the process of independently solving which students accumulate experience in finding solutions [1]. At the same time, part of the knowledge is acquired not in the course of reproducing ready-made truths, but as a product of the search.

The peculiarity of creative tasks is formulated by I. Ya. Lerner as follows: "The difference between a creative task and any stereotypical task is that the path to a solution in a stereotyped task is known, while in a creative task it must be found in the process of creative search" [1].

When compiling creative tasks in social science, such as "Basket of Ideas", "Cluster" technology, original tasks, POPS formula, the syncwine, "Crossense" technology, thematic tests, crossword puzzles, logical chains, etc., it is important for the teacher to awaken active mental activity student [7].

O. Ya. Yaroma draws attention to the wide possibilities of using creative tasks at any stage of the lesson: before learning new knowledge, during the initial consolidation in the classroom, when doing homework, when checking, deepening and improving knowledge, etc. At the same time, the author suggests four forms of organizing problem-based learning: a problematic issue, a problematic story, experimental activity (problem experience), and a problematic conversation. As a special form of work, a didactic game is called [8].So, the creative activity of students in the lessons of social science includes both ready-made knowledge, examples, samples, and search elements.

Thus, the reproducing activity of students is not opposed to creative activity, but is combined with it, and the combination is dynamic.Recognition of the need to use creative forms of organizing the activities of students in the educational process in the lessons of social science is associated with the fact established in psychological and pedagogical research that the assimilation of educational material is much more successful. The study of the course of social science is based on the approval of the active creative and cognitive activity of students, as the leading condition for increasing the effectiveness of teaching the subject.

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UDC 517.445:621.3:004 IMPLEMENTATION OF INTERDISCIPLINARY connections IN SOLVING ELECTRICAL PROBLEMS

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Аннотация. Представлены пути решения вопроса одостаточной квалификации инженеров электротехнического профиля. Для курсантов электротехнических специальностей в качестве примеров используются расчеты электрических цепей постоянного токапри изучении математических методов решения систем линейных алгебраических уравнений (СЛАУ). Авторами представлены примеры разветвлённой расчета сложной схемы постоянного тока с использованием математического аппарата.

Ключевые слова: электротехника, инженеры электротехнического профиля, математический аппарат, электрическая цепь, метод Гаусса.

Annotation. The ways of solving the issue of sufficient qualification of engineers of the electrical profile, which is due to the increase in the complexity of the equipment required in tincture, adjustment and operation, are presented. When studying mathematical methods for solving systems of linear algebraic equations (SLAE), calculations of DC electrical circuits are used as examples for cadets of electrical specialties. The authors present examples of calculating a branched complex DC circuit using a mathematical apparatus.

Keywords: electrical engineering, electrical engineers, mathematical apparatus, electric circuit, Gaussian method.

Introduction. To work with modern high-tech equipment, specialists with the ability to analyze and calculate complex electrical circuits are needed. The issue of sufficient qualification of engineers of the electrical profile is acute due to the increasing complexity of the equipment required for tuning, adjustment and operation [5]. When studying the subject, the theoretical foundations of electrical engineering, cadets rely on the knowledge gained in mathematics, physics, computer science, when studying these subjects in the first year [1].

Due to the study of mathematics, future engineers know how to apply the methods necessary for solving typical professional problems [2, 3].

One of the main skills of an electrical engineer is the ability to calculate electrical circuits, i.e. determination of currents in all branches with known sources of electricity and load parameters [4].

When studying mathematical methods for solving systems of linear algebraic equations (SLAE), calculations of DC electrical circuits are used as examples for cadets of electrical specialties [6].For this, knowledge of physical laws and mathematical methods for solving SLAE, the ability to make the necessary calculations on a computer are used.

Main part.One should consider an example of calculating a branched complex DC circuit (Fig. 1) using a mathematical apparatus.



Figure 1- Electrical circuit diagram

Дано:

$$\begin{split} E_1 &= 100B; E_2 = 110B; E_3 = 220B; E_4 = 230B; \\ R_1 &= 10M; R_2 = 50M; R_3 = 100M; R_4 = 200M; R_5 = 250M; R_6 = 300M; R_7 = 350M; \\ Haŭmu: I_1, I_2, I_3, I_4, I_5, I_6, I_7. \end{split}$$

The currents in the circuit are determined using the first and second Kirchhoff's laws, resulting in a system of seven algebraic equations containing seven unknown currents $I_1, I_2, I_3, I_4, I_5, I_6, I_7$

$$\begin{bmatrix} -I_1 - I_4 + I_5 = 0 \\ I_1 - I_2 + I_3 = 0 \\ I_2 + I_4 - I_6 - I_7 = 0 \\ I_1 R_1 - I_3 R_3 + I_5 R_5 = E_1 - E_3 \\ I_1 \cdot 1 - I_3 \cdot 10 + I_5 \cdot 25 = -120; \\ I_2 R_2 + I_3 R_3 + I_6 R_6 = E_2 + E_3 \\ I_3 \cdot 10 + I_2 \cdot 5 + I_6 \cdot 30 = 330; \\ I_6 R_6 - I_7 R_7 = 0 \\ I_6 \cdot 30 - I_7 \cdot 35 = 0 \\ I_1 R_1 + I_2 R_2 - I_4 R_4 = E_1 + E_2 - E_4 \\ I_1 \cdot 1 + I_1 \cdot 5 - I_1 \cdot 20 = -20$$

To solve the resulting system of linear algebraic equations, we use the Gauss method. One should construct an extended matrix of the system containing the coefficients for unknown currents and the coefficients of the right-hand sides of the system:

(-1	0	0	-1	1	0	0	0
1	-1	1	0	0	0	0	0
0	1	0	1	0	-1	-1	0
1	0	-10	0	25	0	0	-120
0	5	10	0	0	30	0	330
0	0	0	0	0	30	- 35	0
(1	5	0	- 20	0	0	0	20

By linear transformations, the matrix is reduced to a stepped form:

(-1	0	0	-1	1	0	0	0
	0	-1	1	-1	1	0	0	0
	0	0	1	0	1	-1	-1	0
	0	0	0	-1	36	-10	-10	-120
	0	0	0	0	1	-0.5	-0.34211	-4.89474
	0	0	0	0	0	1	-1.16667	0
	0	0	0	0	0	0	1	5.07209

As a result of the transformations, an equivalent system of equations of a stepwise form was obtained:

$$\begin{cases} I_1 & 0 & 0 & +I_4 & -I_5 & = & 0 \\ I_2 & -I_3 & +I_4 & -I_5 & = & 0 \\ I_3 & +0 & +I_5 & -I_6 & -I_7 = & 0 \\ I_4 & -36I_5 & 10I_6 & 10I_7 = & 120 \\ I_5 & -0.5I_6 & -0.342I_7 = & -4.894 \\ I_6 & -1.166I_7 = & 0 \\ I_7 = & 5.072 \end{cases}$$

The values of current $I_1, I_2, I_3, I_4, I_5, I_6$ are given by means of "reverse" of Gauss method $I_1 = -3,0757, I_2 = 8,11465, I_3 = 11,1904, I_4 = 2,87488, I_5 = -0,2008, I_6 = 5,91744, I_7 = 5,07209$ are obtained using calculations in Excel.

Conclusions:

1. An example of the implementation of interdisciplinary connections of mathematics, physics and computer science in the calculation of a branched complex DC circuit, studied in the course of the theoretical foundations of electrical engineering, is considered.

2. The system of linear algebraic equations with 7 unknown currents was solved by the Gauss method.

3. Calculations were made using built-in Excel functions.

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STUDENT'S MOTIVATION INCREASE IN THE COURSE OFLEARNING ENGLISH LANGUAGE

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Аннотация. В статье рассмотрена мотивация как внутренний который стимулирует механизм, человека для достижения определенного результата. Представлены способы повышения мотивации студентов в условиях изучения английского языка. Предложены рекомендации по усовершенствованию процесса обучения.

Ключевые слова: мотивация, методы, потенциал, стремление к обучению, эффективность обучения.

Annotation. The article considers motivation as an internal mechanism that stimulates a person to achieve a certain result. The ways of increasing the motivation of students in the conditions of learning English are presented. Suggested recommendations for improving the learning process.

Keywords: motivation, methods, potential, desire for learning, learning effectiveness.

Introduction.One of the most difficult aspects of lecturers' activity is motivating students. It is one of the most important as well. Unmotivated students don't study effectively as they won't participate in the discussions and some of them may become disorganizers. "Some recent research shows that many students do poorly on assignments or in participation because they do not understand what to do or why they should do it" [13].

The means that can be used to maintain students' interest were presented by Daniel Joseph E. Berdida [8]. Emmanuel Iyamuremye, Irénée Ndayambaje, Charles Magoba Muwonge study the issues of relationships of achievement with self-determined motivation [10]. Gender equity and motivational readiness for computational thinking were considered by Allison Master, Daijiazi Tang, Desiree Forsythe, Taylor M. Alexander, Sapna Cheryan, Andrew N. Meltzoff [11].

Everyone says that motivation is an essential part of learning. The purpose of given study is toconsider motivative students' work in the process of English language learning [3, 4].

Students may be unmotivated for a variety of reasons: they may feel that they have no interest in the subject; be distracted by external factors.

Motivation is an internal mechanism that stimulates a person to achieve a certain result. At the same time, it is quite often confused with such concepts as "goal" or "need". The goal is the desirable result. "Intrinsic motivation is widely considered essential to creativity because it facilitates more divergent thinking during problem solving" [9].

If a person is interested in learning English, then their goal will be to learn the language exactly at the level they want. The need is one to achieve the goals.

For example, a person wants to get an attractive position in a foreign company, but it requires a high level of English proficiency. In this case, the need will be to get a new good job, and the goal is to study the subject at the level necessary for this.

How student' motivation can be increased? One should consider effective methods.

Don't give students much information [1].

Even if the course is chosen according to the level of students, it is not worth present a list of 100 new words for one lesson. It is better to take 10 new words and repeat them several times during the lesson. It is the same with grammar. It is better to repeat the material several times [6].

Practice small rewards.

One can use at least verbal praise, but not just "Well done, good job".

For example, you could say, "Do you remember how a week ago you couldn't use Mix Conditionals without errors, but now you can. This is your effort, well done" [7].

Add variety to your lessons.

A change of scenery is one of the most effective methods that helps to "refresh" students' motivation. It will take a little imagination and your efforts to organize everything. But you will definitely like the result [12].

You can, for example, go to the park for an English picnic, organize a joint trip to the cinema in English.

This will help the students to practice their English and will add pleasant emotions to the lessons.

Maintain a positive atmosphere.

To maintain the atmosphere, it is important not to criticize the students publicly, to support them and let them communicate with each other in different groups with some interesting or funny tasks. Teach students to track progress [5].

The biggest reward for students is their 'language victories'. When a student feels development and progress, they strive for more results. It is important for the educator to teach students to track and record their achievements.

All modern technologies give the best pedagogical effect, naturally increasing the cognitive activity and motivation of students, and ensures the intensification of the learning process and independent activities of students. It is due to the use of computer technologies application in the process of English learning and in extracurricular activities [2].

The latest multimedia technologies help to master the perception of oral speech, correct pronunciation and teach fluent speaking quickly and effectively.Interactive programs and games provide a creation of real communication situations. They remove psychological barriers and increase interest in the subject.

In conclusion one should say that the complex use of all the above mentioned methods in the educational process stimulates personal, intellectual activity, develops cognitive processes, helps to diversify learning activities, and increase motivation to learn English, which ultimately ensure solving problems of language learning and contributes to the implementation of the tasks.

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UDC 81'27/81'25 SOCIAL AND PSYCHOLOGICAL FUNCTIONS OF LAUGH Angelina Seletskaya

3rd year student, Institute of Social Sciences and International Relations Sevastopol State University e-mail: seletskaya.angelina@icloud.com Scientific advisor, AllaMikhaylova senior lecturer of Foreign Languages Department SevastopolStateUniversity Аннотация.В данной статье рассматривается проблема смехового поведения как продукт психосоциального взаимодействия в обществе и среди отдельных индивидов. Целью данного исследования является определение функций смеха в процессе коммуникации. В целом, изучение смеха в социальном и психологическом аспекте отличается большим количеством различных подходов, теорий и методик исследования, что можно объяснить многообразием проявлений смеха в различных социальных группах и между людьми. В заключение отмечено, что при детальном анализе, наблюдается пересечение изначальных предпосылок и смыслового содержания, поэтому при выделении отдельной функции некоторые аспекты, будут служить фундаментом для нового определения.

Ключевые слова: смех, человек, группа, функции смеха, общество.

Annotation. This article deals with the problem of laughter behavior as a product of psychosocial interaction in society and among individuals. The purpose of this study is to determine the functions of laughter in the process of communication. In general, the study of laughter in the social and psychological aspect is distinguished by a large number of different approaches, theories and research methods, which can be explained by the variety of manifestations of laughter in various social groups and between people.In conclusion, it was noted that in the context of a detailed analysis, there is an intersection of the original prerequisites and semantic content; therefore, when highlighting a separate function, some aspects will serve as the foundation for a new definition.

Keywords: laughter, person, group, functions of laughter, society.

Introduction. The study of the sense of humor has attracted researchers from antiquity to the present day. At the moment, there are many theories trying to explain this sociocultural and psychological phenomenon [7]. Laughter is a kind of product of psychosocial interaction, so it needs to have two sides - the subject (the one who laughs) and the object (who/what is laughed at).

A.Bergson considers laughter in the broadest social aspect. He believes that laughter can only be understood within the framework of society itself. "There is no comic outside of the proper human" [1, p. 128]. A. Bergson also describes detail the essence of the phenomenon in more. "In order to understand laughter, it must be transferred to its natural environment, which is society; in particular, it is necessary to establish the useful function of laughter, which is a social function ... Laughter must meet certain requirements of the common life of people. It has a social importance" [1, p. 128].

It is worth mentioning that A.Bergson stated the main function of laugh - the correction of society. Many types of comedy (comic types include satire, humor, irony, sarcasm,) can be examples of insults in society, to which it usually responds. In this regard, laughter acts as a defensive reaction or a psychological defense against stress. D. Robsonconsiders that laughter is much more than just jokes [13]. M. Pfundmair said that Oxytocin was known for facilitating interpersonal interactions in favorable conditions. "Humor, on the other hand, is an interpersonal phenomenon that reduces social distance. In this study, we investigated whether Oxytocin would increase laughing and smiling in a favorable environment" [12].

The purpose of this study is to determine the functions of laughter in the process of communication.

Main part.Feature include/exclude. S. McAdams describes two main directions that "govern human behavior: the first direction is the desire to establish oneself in one's own individuality, and the second - to a sense of belonging" [9, p. 370]. Based on the first trend, people try to express their status or personal judgments through humor, as well as to keep control over the situation. The second tendency shows a desire to be involved in a reference group or an individual. Two trends work to create or reduce social distance because laughter helps to keep people close. This function is one of the key factors that form the structure of the group, performing not only the method of inclusion / cohesion of the group, but also exclusion from it [2, p. 214]. So some group of researchers believes that through laughter we are trying to isolate ourselves, to abstract ourselves from some unpleasant irritants of the world around us.

One should define the functions of laugh.

Group cohesion function. Laught is one of the strongest methods of group cohesion, since during such euphoria, people are "on the same wavelength", they begin to be united not only by like-mindedness, but also by the same orientation towards the object, action or statement that causes laughter. Emotional solidarity with others contributes to the assimilation of models of social behavior, which is carried out by the group. Laughter within the group usually contributes to its cohesion and is a sign of cohesion [2]. F. Glenn in the monograph "Laughter in Interaction" considers joint laughter as an indicator of "partnership".

The function of attaching to a subject/group. Laughter can serve as a way to connect with the reference group, show devotion or earn someone's recognition. People confirm that they belong to the same circle of people with common interests by supporting a joke with laughter. But keep in mind that a person can imitate laughter to fill awkward pauses or show interest in a conversation. "However, they can only pretend to create the appearance of cooperation" [11].
The function of hiding true feelings. This function is usually used when a person does not want to show their personal experiences, thoughts, feelings or resentment, so as not to hurt the feelings of others or break off the relationship. According to the theory of detente, a person who has to cope with surging feelings in a tense situation in a group begins to laugh, thereby laughter acts as a valve that releases steam [5]. Such a response helps in difficult situations to continue to communicate effectively, obviously doing harm have trouble doing it.

Sigmund Freud was one of the first researchers to consider humor as a protective tool. "Defensive processes," he writes, "are psychic indicators of the flight reflex and have the goal of preventing the occurrence of displeasure. Then they serve as an automatic regulator for mental life, which, in the end, of course, turns out to be somehow defective for us and must therefore be suppressed by conscious thinking ... Humor can be understood as the highest of these protective functions "[8, p. 401].

Freud believed that laughter decreases the tension created by the constraints of social norms. Such relax creates a sense of satisfaction, even if temporary, among the participants in the conflict and contributes to the resolution of problems [14].

Identification / differentiation function. Different groups use markers to indicate identity with her. Gestures, clothes, language, hairstyles, jokes can serve as markers of group identity, they work as the main sign by which members of the group recognize their own kind and separate themselves from others. In group interaction, when laughter creates in people a sense of unity, sharing of common values and a sense of "we are a group", the function of group identity is performed. According to F. Glenn, the identification function is the main one [10, p. 190]. With demonstrative disregard and lack of sympathy due to personal motives, differentiation is realized within or among groups [6].

Emphasis function / status differences equation. Laughter can act as a means of weakening status differences, if in such communication a third person or a person who does not mind being the subject of ridicule acts as the object of laughter. According to A. V. Dmitriev, joint laughter helps to temporarily remove social hierarchical differences [3, p. 592]. The effect of equalizing status differences helps workers to better communicate with superiors and develops self-confidence in both groups [6].

With intense interaction between different groups, as well as between individuals, relationships can be changed, mostly in a positive way, under the influence of humor. The result can be a reassessment of the existing relationships that lead to the creation of a "bridge" between competing groups [2]. The parties usually fear humor and satirical intentions, seeing them as a threat or an insult to themselves in conditions of clear conflict. The function of gaining / losing social status. This function is closely related to the inclusion/exclusion function, as laughter can be used to reinforce one's status in the group hierarchy. According to R. Alexander, "with public (demonstrative) ridicule, laughter helped to raise the status of the ridiculer in the group and lower the status of the ridiculed" [4, p. 152]. In this case, the ability to cause laughter can be seen as a tool in the struggle for position in society.

As mentioned above, a person who has a developed sense of humor can strengthen their status. It is also important to note that a person who can withstand ridicule by fighting back with a "reciprocal joke" has the same chance of increasing status or joining a group. Thus, among prisoners, the principle of accepting a person into a group through the initiation of "registration" is traced, during which it turns out how much a person is able to take pain seriously, to abstract from violence; in such an initiation, it is important to show that you are not offended, since in the future you can become the subject of constant ridicule.

Conclusion. Thus, the main functions of laughter that are found in society were considered. The knowledge analyzed in given study provides a better understanding of the interaction of a group or individual within the framework of this emotional phenomenon. In a detailed analysis, there is an intersection of the original prerequisites and semantic content; therefore, when highlighting a separate function, some aspects will serve as the foundation for a new definition.Таким образом, были рассмотрены основные функции смеха, которые встречаются в обществе.

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MORAL AND PSYCHOLOGICAL BASES OF PHYSICAL EDUCATION IN SOKOLSK GYMNASTIC SYSTEM

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Аннотация. Одной из национальных систем в Европе физического воспитания XIX века являлась Сокольская гимнастическая система, которая возникла в Чехии. Проанализированы идейно-педагогические основания Сокольского движения касательно воспитания всесторонне развитой личности. Рассмотрены морально-психологические задачи для развития воли, формирования патриотизма и физических качеств у юных соколов.

Ключевые слова:физическое воспитание, здоровье, Сокольская система, физическое воспитание,Сокольское движение, Чехия.

Annotation. It is established, thatSokol gymnastic system was one of the national systems of physical education in Europe in the XIX century, which arose in the Czech Republic. The ideological and pedagogical foundations of Sokol movement associated with the education of a comprehensive h developed personality are considered. The moral and psychological tasks of will forming, patriotism development, and physical qualities forming in young Sokolpupils are analyzed.

Keywords: physical education, health, Socol system, Sokol movement, the Czech Republic.

Introduction.

There are countless ways to approach teaching as well as there are many ways to teach a student. Learners have a few of their own methods, and a variety of ways in which they "reached" their students. But it is necessary to take into account the best world methods and tactics.

In the XIX century, various pedagogical theories appeared in different countries of Europe with new ideas in the field of physical education.

One should take into account the practice of physical education. National systems of physical education began to be created in almost all capitalist countries [1]. Gymnastics had not been defined as a specific form of physical educationby the beginning of the 19th century. Nevertheless, it contained all the elements of physical education known at that time: throwing, wrestling, fencing, walking, running, jumping, swimming, skating, games, etc.

The national gymnastic movement was accompanied by the desire of a separate nation to consolidate and strengthen statehood. It was established as a non-profit organization founded to provide competitive gymnastics in a simplified format with general rules and deductions.

One of these systems was Sokol gymnastic system of Miroslav Tyrsh, which arose in the Czech Republic. Physical education was of paramount importance in the context of the philosophy of Sokol movement and it was an integral part of Sokol movement. That phenomenon appeared in the form of a creative, creative activity of a person, reflecting the process of becoming a person as a whole. Thus, "the level of physical development was considered as a full-fledged component of a harmoniously developed person" [10].

The purpose of the study is to analyze Sokol gymnastic system, which is considered one of the national systems of physical education in Europe in the XIX century.

The ideas generated by the French Revolution caused an intensification of the socio-political movement throughout Europe at that time, which by the middle of the century resulted in a number of revolutionary speeches. The general desire for independence and freedom also penetrated into the Czech Republic, which began the struggle for national liberation. In this era, Sokol movement appeared, which, gradually developing and improving, turned into a noticeable social phenomenon in Slavic states, primarily in Russia.

Sokol movement task was the will formation [6]. The Sokol system of gymnastics is the first significant Slavic system of physical education was used as a symbol of freedom, courage, independence. It provided development of such positive character traits as courage, discipline, perseverance, determination, and self-control.

In the Czech Republic, this organization was headed by people of rare energy and outstanding moral qualities: the founders M. Tyrsh and I. Figner, who donated all their fortune to create the material base of the Sokol and build the first Prague Sokol pupils.

One of the key tasks of Sokol movement was the task of physical education, since, according to M. Tyrsh, "only a healthy people is armed, capable of defending its independence and the right to life" [9, p. 24]. Therefore, "the immediate goal of bodily education and gymnastics is to strengthen the human body, develop physical resistance, which we understand as a set of physical exercises; the ultimate goal is all-round health, all-round strength, all-round beauty of a person" [8, p. 12].

In his book « Sokol movement» admitted the main goal of Sokol principle – education of a comprehensive and harmoniously developed personality. The general purpose of Sokol was to "to preserve freshness, health, physical, mental and moral traits in people" [9, p. 19]. The following tasks were set for physical education by M. Tyrsh:

1) "to bring to full development all his functions and abilities within the limits of natural and innate talents" [3];

2) "to form the human body" [2];

3) "to ensure and strengthen the greatest wealth of a person – health, so that everyone can become a good worker" [3];

4) "to achieve the goal when everyone can use the acquired forces for successful workin life as long as possible" [2].

The complexity of Sokol education tasks was reflected in the variety of means included in the gymnastic system. A step forward was that in Sokol gymnastics attention was paid not to the number of repetitions, as was the case in German and Swedish gymnastics, but to the beauty of their performance, which was supplemented with elements of sports, mass performances, games and dances along with various elements of gymnastics [7].

A graduate of the University of Prague, M. Tyrsh, being a representative of the bourgeois intelligentsia, sought to unite and rally the Czech people to participate in the national liberation struggle against the Austrian conquerors. He created his own system, which was based on German gymnastics. He emphasized "the great importance of gymnastics both for individuals and for the people as a whole, namely from the point of view of health, the national economy, defense, education and aesthetics" [2, p. 18].

The specific tasks of Sokol education are ones for optimizing individual physical development, i.e. general pedagogical tasks are the formation of the morality of Sokol pupils through physical education and preservation of health; educational tasks are the rational formation of applied skills and knowledge in physiology, physical culture and sports.

The solution of these problems was achievedby means of the implementation of key areas of physical education of Sokol pupils: gymnastics as a main direction of physical education, sports (including fresh air lessons) and practical familiarization with hygiene. Gymnastics was this kind of sport that became the basis for the creation of Sokol movement. Classes were held according to the following scheme: first, free movements, exercises with shells and combat, then there were exercises on shells in subgroups, then general exercises (pyramids), finally, drill again, after which classes ended.

It should be noted that the Czech "Sokol pupils" took an active part in international competitions, such as the competitions of the "Union of European Gymnastic Societies". In 1907 Czech Sokol pupils took part in the competitions of the European Union in Prague (pict. 1), then in Luxembourg (1909), Turin (1911), Paris (1913). Meetings of gymnasts were held in Prague, up to 20 thousand people participated in them.

In 1911, they became the winners of international competitions, leaving behind all the representatives of the nations that were members of the European Union. In addition to gymnastic exercises, the competition also included elements of athletics: shot put, high jump with a pole, 100-meter run.

The Sokol pupils played a huge role in the development of literacy and education among their people. The Czechs have proven themselves to be good gymnasts, known in history as a "nation of gymnasts".



Picture 1 – The Sokol movement in Prague

Czech Sokol pupils took part in the World Gymnastics Championship in London (1910) [2].Sokol pupils demonstrated their achievements during a sports festival on the Champ de Mars in 1912. The chronicle footage, in which dozens of gymnasts consistently repeat the same movements, makes us remember the massive yoga and kung fu training sessions that are gaining popularity in the 21st century. Another "calling card" of the movement was gymnastic multi-storey "pyramids".

Sokol movement spread across all Slavic regions as one of the foundations for the development of modern artistic gymnastics. The organization also served as an early precursor to the Scouting movements. The Sokol system of gymnastics is the first significant Slavic system of physical education, called "Falcon" - used as a symbol of freedom, courage, independence. In the Czech Republic, this organization was headed by people of rare energy and outstanding moral qualities.

Conclusion. The Sokol played an important role in the development of spotr and physical training direction. The Sokol gymnastic system was the first Slavic system of physical education, which received wide recognition in Russia at the end of the XIX century. In the domestic literature, there are no studies covering the methods of Sokol organizations work.

The analysis of physical education means and forms made it possible to make a conclusion Sokol movement is a pedagogical process aimed at and the development of the physical qualities and the formation of motor skills of Sokol pupils.

The characteristics of Sokol gymnastic system principles allows to emphasize that the basic physical education positions, related to the applied and health-improving orientation and the harmonious development of the personality, are reflected in the Sokol pupils in the best way.

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UDC 378

THE RELEVANCE OF THE PROFESSION OF A NUCLEAR PHYSICIST

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Аннотация: Профессия физика-ядерщика довольно молодая, ее появление связано с появлением и развитием ядерной физики и, как следствие, необходимостью и востребованностью специалистов в этой области. Физики-ядерщики занимаются исследованиями, контролем, наблюдением за ядерными реакторами, осуществляют научную и преподавательскую деятельность, непосредственно работают с радиоактивными веществами и т.д. Отдельного внимания заслуживает профессия военного физика-ядерщика, в связи с чем, в работе сделан акцент на подготовку курсантов будущих физиков-ядерщиков высшими военными училищами и, в частности, Черноморским высшим военноморским ордена Красной Звезды училищем имени П.С. Нахимова.

Автором сделана попытка проанализировать положительные и отрицательные стороны профессии, изложить какие требования предъявляются к физикам-ядерщикам, какими качествами они должны обладать, где и как обучают таких специалистов, какую карьеру они могут для себя избрать.

Ключевые слова: подготовка физиков-ядерщиков, профессия физик-атомщик, востребованность, актуальность, карьера, обязанности.

Annotation: The profession of a nuclear physicist is quite young, its emergence is associated with the emergence and development of nuclear physics and, as a result, the need and demand for specialists in this field. Nuclear physicists are engaged in research, control, monitoring of nuclear reactors, carry out scientific and teaching activities, directly work with radioactive substances, etc. The profession of a military nuclear physicist deserves special attention, in connection with which, the work focuses on the training of cadets of future nuclear physicists by higher military schools and, in particular, by the Black Sea Higher Naval Order of the Red Star School named after P.S. Nakhimov. The author made an attempt to analyze the positive and negative aspects of the profession, to state what requirements are imposed on nuclear physicists, what qualities they should have, where and how such specialists are trained, what career they can choose for themselves.

Keywords: nuclear physicist training, profession of nuclear physicist, demand, relevance, career, duties.

Physics occupies one of the dominant positions among all the fundamental sciences of nature. Scientists have been involved in studying and explaining the mysteries and laws of this science since the earliest timeandit is difficult to overestimate versatility of this particular science. But perhaps the most mysterious sphere is nuclear physics. Of course, an important role in any science is played by a person, in our case, a nuclear physicist.

Nuclear (atomic) physics is a science that studies the structure and properties of atomic nuclei and their transformations. It is based on the experimental data about radioactivity and nuclear reactions.

The history of the profession of an atomic engineer began at the end of the 19th and the beginning of the 20th centuries, when scientists discovered the atom and determined the structure of its nucleus, radioactive decays, etc. The work of the physicists in the first half of the 20th century was dedicated to studying the properties of the atom, atomic energy, and researching its destructive power. The atomic nucleus, proton and neutron attracted the close attention of physicians, chemists, biologists and technologists. But the dominant role was taken by nuclear physicists.

The history of nuclear physics started in 1896 when H. Becquerel investigated phosphorescence in uranium salts and discovered the phenomenon of radioactivity [4].Further development was connected with the name of E. Rutherfordwho described two types of rays - alpha and beta - emitted by atoms. Working together with F. Soddy they put forward the theory of radioactivity, stated andformulated the law of radioactive transformations. In 1904 the term "half-life period" was introduced by E. Rutherford. Later in 1908 together with H. Geiger they constructed an instrument called "Geiger counter". Some years later in 1911 E. Rutherford supposed the existence of positively charged nucleus in an atom and put forward the idea of planetary model of the atom (Rutherford atomic model). Further development of nuclear technology is connected with the name of N. Bohr, who worked out and presented a picture of atomic structure and quantum theory.Later he took part in the development of American atomic bomb in Los-Alamos.

The cooperation of another scientists O. Hahn and F. Strassmann resulted in the discovery of the fission of uraniumin 1939which created the base for the future development of the atomic bomb [4]. And in 1942 E. Fermi created the first nuclear reactor which promoted the idea of using nuclear power and the possibility of creation of nuclear weapons.

As we see, the history of nuclear physics is connected with discoveries and names of famous scientists, such as H.Becquerel, E.Rutherford, F.Soddy, H.Geiger, O.Hahn, N.Bohr, E.Fermi and others who were devoted to this powerful and dangerous science.

During the Soviet period the work and discoveries of the most prominent physicists, such as: Sergey IvanovichVavilov (1891-1951), Igor Yevgenyevich Tamm (1895-1971), VitalyLazarevichGinzburg (1916-2009), Lev Davidovich Landau (1908-1968), Andrei Dmitrievich Sakharov (1921-1989), PyotrLeonidovich Kapitsa (1894-1984), Igor Vasilyevich Kurchatov (1903-1960) contributed to the development of Soviet nuclear science.

While the first stage in the history of the development of nuclear physics was connected with studying and experimenting with phenomena of this science the latest period has been devoted to solving problems concerning the effects of radiation onhumans and theenvironment, the disposal of nuclear waste, the use of nuclear power for peaceful purposes etc., which stimulated the interest of scientists and appearance of such a profession as "nuclear physicist".

The profession of a nuclear engineer is associated with considerable risks, therefore, the requirements for candidates are rather high. As you know, nuclear physicists work with radioactive substances which half-life sometimes exceeds millions of years (for example, the half-life of plutonium-239 is 24 thousand years, and uranium-235 is 700 million years)[7; 12]. That is why the profession can be called risky, besides physicists have a huge responsibility for the whole humankind and Earth.

Nowadays nuclear physicists can work in private or public sphere and perform scientific and teaching activities. As a rule, this activity is closely connected with research, control, and monitoring of nuclear reactors. It is worth mentioning that the prospects in the nuclear industry seem almost fantastic. Nuclear engines for spacecraft are already being developed, which will make it possible to travel beyond the Solar System in the future.

In order to obtain this profession, the person will need a higher education which due to the specificity of profession supposes serious loads and a rather complex training program. First of all, a specialist needs to know the basics of physics, mathematics and other sciences well. Given that the work is quite specific and requires certain qualities and skills, it is not suitable for everyone. A future physicist should have relevant analytical and critical thinking skills, a disposition for logical rational analysis, and be able to perform mathematical calculations. The specialist must show perseverance, high concentration of attention, the ability to make decisions in emergency situations and take responsibility. In addition, a number of specific requirements are also put forward for the personal qualities of students/cadets, for example: efficiency of thinking, developed intuition, neatness, foresight, pedantry, the ability to keep a secret, emotional balance, etc. [11, p. 410].

At the same time, the qualities that hinder the effectiveness of professional activityshould be noted:

insufficient development of analytical thinking and mathematical abilities; irrationality, carelessness, thoughtlessness; emotional instability; inability to keep a secret [11, p. 410].

Each specialist can choose career prospects for himself. One of the simplest is considered to be working in construction and installation organizations. A completely different level of qualification is required at design and pre-commissioning enterprises. For those who are not attracted to work in production, research institutes propose work in scientific sphere. Depending on the place of work, a nuclear physicist specializes either in research activities (these are nuclear scientists in various research institutions), or as an operator (these are nuclear power plant employees who

are engaged in the operation of nuclear power plant equipment, nuclear and thermonuclear installations).

A separate field of activity is the military profession. Modern types of weapons make extensive use of nuclear energy. The thorough study and confident knowledge of nuclear physics is mandatory here. So, a nuclear physicist is a difficult and at the same time interesting profession. This is a specialist whose activity is related to nuclear installations.

Areas of professional activity include: aerospace and defense industry, energy and nuclear industry, scientific research in laboratories, teaching activities.

Nowadays, young physicists graduating from universities are in high demand, and first of all, those specialists who are involved in research problems at the junction of several interdisciplinary sciences. For example, one of the prominent directions of the activity of a nuclear physicist is concerned with obtaining energy from new, more economical sources. On the other hand, energy engineers are still required in any production. The profession provides for career growth and is currently active, due to the highinterest in nuclear energy, nuclear weapons, and the development of the latest thermonuclear weapons.

Some of the directions of the professional activity of a nuclear physicistinclude the following: to implement control over the processes, to search for errors, to identify and to eliminate their causes. The specialists can work indoors and outdoors. As at the earliest stage of the nuclear physics development, when famous scientists cooperated and shared information with each other, nowadays information exchange with colleagues with the help of technical means of communication is vital for successful performance of the activity.

Job responsibilities of a specialist working with nuclear products and equipment:

- taking over duty, checking the workplace, the state of serviceability of equipment (centralized control systems, sensors, building structures);

- taking dosimetric measurements, monitoring of radiation and radioactive substances;

- registration of elementary, charged and neutral particles, registration of the movement of charged particles;

- analysis of physical results;

- processing of the received data, monitoring the condition of the equipment, removing indicators;

- regulation and monitoring the safe operation of facilities, account and control of nuclear materials and radioactive substances;

- control of fuel resources and assessment of their reserves, accounting of fuel reserves consumption, monitoring spent nuclear fuel storage [8].

Nuclear physicist, as a profession, appeared only at the end of the last century, when more attention was paid to nuclear weapons, the introduction of nuclear power plants into power grids, so the need for professionals who are ready to move from the theory of studying the atomic field into practice also appeared not so long ago.

Thus, at nuclear power plants or at facilities where nuclear weapons are used, a nuclear physicist is a profession that does not involve scientific work, these are those who maintain such equipment.

Let's look at the advantages and disadvantages of the profession of a nuclear physicist. As for advantages, the following points should be taken into consideration:

- the demand for specialists in this field in Russia;

- the right to choose a place of work (public, military/defense and private institutions);

- the opportunity to find a civilian job abroad at foreign enterprises.

If we consider the disadvantages, there are not many of them, but they are significant and must be taken into account:

- great responsibility (even a small mistake can lead to fatal consequences);

- lack of global scientific research at enterprises (unfortunately, the practical side of the profession does not involve scientific discoveries);

- health effects (regular interaction with nuclear equipment can have negative consequences).

When we consider the application of nuclear physics in defence, medical, energy and other spheres we should take into account all the possible effects of such activities. Accidents on nuclear submarines and nuclear stations, the disposal of radioactive waste, the extraction of uranium ores pose threat to people's lives and nature. So, the specialists working with nuclear energy must keep in mind the effects on the humankind, environment, and Earth.

One of the most dangerous effects of work in this sphere is radiation sickness which is the result of irradiation of the entire body (or more of the body) by high dose of penetrating radiation for a very short period of time. The severity of illness depends on the type and dose of radiation, localization of the source of radioactive substances, dose distribution over time and the human body. Radioactive substances may get into the body with inhaled air, through the skin and mucous membranes, through the gastrointestinal tract as well as by means of injection.

The severity of radiation sickness depends on the doses a person receives: doses up to 1 Gy (100 rad) cause relatively mild changes; doses over 1 Gy cause bone marrow or intestinal forms of radiation sickness of varying severity depending mainly on the lesion of the hematopoietic organs. If a

person receives single radiation doses of more than 10 Gy, these doses are considered absolutely fatal.Radiation can influence and effect human tissues, organs and systems.

The effects of radiation exposure include:

- sclerotic processes;
- radiation cataract;
- metabolic disorders;
- malignant tumors;
- leukemia;
- cancer;
- mutations;
- changes in the reproductive system, infertility;
- neuropsychiatric disorders;
- shortening of life expectancy[5, p. 378-402; 2, p. 408]

The training of future nuclear physicists takes place in higher educational institutions, usually at specialized faculties of universities and naval schools. Special attention should be paid to the training of military nuclear specialists who are involved in the creation of new types of weapons and their maintenance. This is a weapon of virtually unlimited power, capable of repeatedly destroying all life on Earth.

Military universities, and in particular, the Nakhimov Black Sea Higher Naval School of the Order of the Red Star train nuclear physicists capable of servicing and using nuclear weapons. Many graduates of the Black Sea Higher Naval School performed real feats and were presented with state awards [9]. For example, a 1941 graduate of the school, Hero of the Soviet Union Admiral Anatoly Sorokin, was the first to lead a detachment of Soviet nuclear submarines under the pack ice of the Arctic. A 1952 graduate of the school, Hero of the Soviet Union Rear Admiral Vadim Berezovsky commanded the lead nuclear missile submarine of Project 667A - the strategic submarine K-137 Leninets with 16 ballistic missiles on board. In August – September 1994, the nuclear submarine "Omsk" under the command of a 1977 graduate of the school, Captain 1st rank A. Astapov, in difficult hydrometeorological and ice conditions, entered the high latitudes of the Arctic Ocean. The submarine passed under the ice about 4,000 miles for 15 days[10, p.5].

The absolute majority of graduates of the Nakhimov Higher Naval school treated the assigned task with great responsibility and became excellent specialists and commanders. In the history of the Navy and the School, they will forever remain naval officers - knights of the "Cold War", who stood at the origins of the foundation and development of the nuclear missile fleet of the Soviet Union [3].

According to G. A. Goncharov, who worked with A.D. Sakharov, nuclear scientists in the 1950s perceived nuclear weapons as a political rather than military weapon and considered that it would never be used for its intended purpose. At that time scientists considered nuclear weapon as an instrument of peace, which could force potential opponents to "fraternize" [1, p. 110].

Since the earliest time of nuclear weapons development it has become clear that the processes of production, testing and storage of them are connected with considerable danger. Scientists involved in the development of nuclear technology searched and proposed effective ways to reduce this danger. Yu. B. Khariton, one of the main figures of the Soviet atomic project (along with I. V. Kurchatov, A.D. Sakharov and Ya. B. Zeldovich) put forward his Khariton's concept of responsibility, which was summarized in several simple and effective principles:

"1) know ten times more than you need to solve any question;

2) personal responsibility of employees for solving any issue, whether it concerns scientific research, design solutions, development of technical devices, etc., including their own personal responsibility for the whole matter;

3) tell the truth to the authorities and management about the state of affairs, about possible consequences;

4) constantly work on the second main problem of nuclear weapons - ensuring security, (the first problem of nuclear weapons is the creation of "products")".

This approach and the personal efforts of Yu. B. Khariton ensured a lower level of accidents with nuclear weapons in the USSR than in the USA [1, p. 112].

In conclusion, it is worth saying that scientists continue working with nuclear technology using its power and potential for peaceful and military purposes. Radiation is invisible, it cannot be felt, there is no escape from it.The atom cannot be called safe, everything connected with the nuclear field is in many ways detrimental to all living things. Numerous burials of radioactive waste can contribute to the quiet death of the planet.The history of nuclear technology development is closely connected with several catastrophes which remind humankind of the great power and at the same time great danger the nuclear atomspossess. So, we should remember the accidents which happened in the past and the lessons taught by our great scientists who founded and developed nuclear physics. And as for our future nuclear physicists, the process of their training requires considerable efforts both from teachers and from cadets because apart from specific knowledge, skills and abilities they also need to possess certain personal traits and understand their great responsibility for the results of their work.

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UDC 373.29

CADETS' PERSONAL AND PROFESSIONAL DEVELOPMENT

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Senior Lecturer, Foreign Languages Department P.S. Nakhimov Black Sea Higher Naval School Sevastopol Аннотация. Рассмотрены основные способы личностностнопрофессионального развития в контексте модернизации высшего образования. Становление будущего офицера российской армии рассматривается как комплексное развитие личности.

Ключевые слова: личностно-профессиональное становление, психологическая готовность, курсанты, проектная деятельность.

Annotation. The main ways of personal and professional development in the context of the modernization of higher education are considered. The formation of the future officer of the Russian army is considered as a complex development of the personality.

Keywords: personal and professional development, psychological readiness, cadets, project activities.

Introduction. The process of modernizing domestic education today is considered to be a comprehensive, comprehensive renewal of all parts of the educational system and all areas of educational activity in accordance with the requirements of modern life [8, 9]. It is aimed today "at humanizing and improving the quality of education" [13, p. 74].

The individualization of education dictates the importance of creating new models of education and training that provide an effective solution to the problems of personal and professional development of future specialists [1]. The personal and professional development of future graduates was studied by I.A. Zimnyaya [3], E.F. Zeer [2], N.S. Pryazhnikov [12], V.N. Sulima [13] etc.

Both historical aspects and modern features of the personal and professional development of cadets of military educational institutions were characterized by A.S. Markov [5], O.A. Mosina, S.A. Khazova, R.G. Redun [10], O.V. Kondratieva [4], N.A. Medvedenva [6], L.N. Khovrina [14], V.A. Pestov [11] and others.

The purpose of this study is to determine the possibilities for the formation of personal and professional skills within the framework of military universities.

The main material. "Professional development is impossible without personal development" [13, p. 77], that is, we consider the formation of the future officer of the Russian army as a complex development of the personality. Moreover, high-quality solution of military-professional tasks often requires the unification of the subjects of activity [10].

The educational process contributes to the mastery of activity, which underlies the formation of personality and is aimed at solving the problems of education and personal and professional development of cadets. The educational process acquires the organizational property of integrity in the event that interaction is provided between teachers and cadets [15]. Many researchers have studied the theoretical acmeological foundations of personality development that meet the needs of reforming society [1, 7, 15]. In modern conditions, society needs scientifically based means of personality development [8].As stated by A.A. Derkach, a profession as a system of activity tasks requires specialists with professionally important qualities. A person as a subject of activity requires the profession to be able to reveal their creative potential and self-realization [1].

According to many scientists, professional standards should provide a solution to professional and psychological problems of improving the professional activities of specialists in accordance with innovative requirements [8].

Analyzing the works of domestic authors, it is possible to identify the directions of personal and professional development: the development of spiritual and moral potential; development of a life position; development of professional orientation; self-actualization of cadets in activity; development of initiative and creativity [3, 12].

It is possible to define a cadet of a higher military naval school as an adult, since he has such qualities as civil law maturity, social viability, responsibility for service, and economic independence [5].

The formation of professional and personal qualities implies mastering the algorithms for solving professional problems, changing the system of values, improving the style of activity [7].

As the analysis of scientific publications and our own experience of work in P.S. Nakhimov Black Sea Higher Naval School in connection with the special regulations of military educational activities, the activity of cadets is not always permissible, and also it is impossible for cadets to completely independently choose the forms, time, content of educational activities, etc. [10]. Therefore, we believe that one of the prospects for the personal and professional development of cadets is the organization of interaction between teachers and cadets, which is formed in research activities that can motivate the activity of future officers.

Personal development implies professional and moral enrichment of the individual, increased activity, sense of duty, honor, responsibility; change in the direction of the personality; expanding the range of interests; actualization of achievement motives; increasing need for self-development. The following are considered professionally important and personal qualities: initiative, organization, acmeological invariants of professionalism (self-regulation, psychological readiness for activity, the ability to make decisions, figurative sphere, etc.) [16].

Psychological factors that can hinder professional and personal development are: uncertainty of goals and motives for achievement, unpreparedness for activity, negative moral and psychological climate [7].

Conclusions. In the context of the development of Russian education, the tasks of improving the training of a highly qualified officer as a modern personality capable of self-improvement are being updated. The most important element of the personal and professional development of cadets is also research activity, in the process of which the activity of cadets is formed.

Thus, the special target orientations of military professional education on corporate culture, collectivist education, as well as specific organizational conditions make it difficult for the lecturer to work, focused both on the professional transmission of knowledge and on the actualization of the cadet's personal development.

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LANGUAGE COACHING AS A FORMAT FOR TEACHING ENGLISH

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Аннотация. Анализируются коучинговые технологии, представляющие эффективность в обучении иностранному языку. Языковой коучинг как формат обучения английскому языку обеспечивает формирование мотивации, способности противостоять стрессу, умения ставить цели и задачи.

Ключевые слова: иностранный язык, мотивация, языковой коучинг, постановка целей, модель SMART, GROW.

Annotation. The coaching technologies that represent effectiveness in foreign language education are analyzed. Language coaching as a format of

teaching English provides the formation of motivation, the ability to withstand stress, set goals and objectives.

Keywords: foreign language, motivation, language coaching, goal setting, SMART, GROW model.

The relevance of this topic is in the fact that the coaching approach application ensures the high involvement of cadets in the process of learning a foreign language. This approach contributes to the development of the skills of "self-organization of activities, taking into account individuality.

"Coaching" (from English – consulting, training) is an approach to organizing the educational process, a method of individual learning in the form of interactive communication. Forms of coaching can be interpersonal and group communication, question-answer discussion, the duration of which is determined by the educator [3].

Language coaching provides cadets' internal potential mobilization and optimization of learning time. This is a format of teaching English, the cadet is taught to manage motivation, resist stressful situations, manage time, set goals and objectives, and master the necessary grammar and vocabulary.

The principles of language coaching in teaching foreign languages were studied by O.I. Lytkina, A.Yu. Ponomarev [4]. A.S. Melnichuk considered the ways of using coaching in the scientific management of final qualification works. Coaching as an innovative educational technology was studied by Yu.B. Kostrova The founder of coaching is T. Galvey, an American business coach, who defined it as the disclosure of a person's potential. "Coaching does not teach, but helps to learn" [9].

Foreign scientists wrote about individual coaching as a way to improve the quality of education [6, 7, 8, 10]. The purpose of this study is to analyze language coaching which is an effective, interesting, accessible language learning.

A foreign language is a learning process associated with persons' consciousness and mental activity [5]. "Language coaching" as an integrated approach to foreign language learning increases the awareness of activities and the development of self-management skills. The teacher should control not only the assimilation of grammar and vocabulary, but also obstacles to communication - language and psychological barriers, i.e. fear of communication in a foreign language

To set a goal, **SMART** technique is used:

S (*special*): it is necessary to specifically formulate the goal;

M (*measurable*) - it should be determined what are the ways to achieve the goal, this provides a correct assessment of the result;

A (*achievable*) - the goal for students must be achievable. At each stage we complicate it, but, in any case, it is possible to achieve it;

R (*relevant*) - the tasks set to achieve the goal must be really feasible;

T (*time-bound*) - time management, as one of the characteristics of this technology, allows to achieve the goal for a certain period of time.

The key function of a coach is to provide psychological support to students on their way to achieving the goal of mastering a foreign language. The task of the educators is to eliminate worries about the mistakes, to motivate cadets, to help achieve an increase in the efficiency of the work done [2].

One of the productive technologies of language coaching is **GROW** model. This technology provides the goalevaluation.One can use the methodology to achieve the goal:

G (goal) - goal setting;

R (reality) - identification of real conditions for achieving the goal;

O (obstacles) - analysis of obstacles that hinder the fulfillment of the goal;

W (way forward - steps forward) - creating an action plan to overcome obstacles [5].

Examples of coaching tools can be:

1. Open and closed questions when repeating vocabulary.

An open (special) question requires clarification. In a foreign language, it allows you to give a description or express an opinion to obtain information.

2. Model - T is used to specify the goal: extension questions, for example, cadets are divided into groups, where they ask questions. These technologies used in learning a foreign language not only contribute to effective language acquisition, but also to overcome the psychological barrier of communication - a mental state that manifests itself in the fear of making a mistake in communication, receiving negative feedback, etc. [1].

The emotional mechanism of the language barrier is to strengthen negative attitudes, which affects the quality of foreign language communication. The teacher-coach maintains cadets' self-confidence and influences the formation of adequate self-esteem.

It should be concluded that there is currently a search for effective approaches to learning.In foreign language education, active teaching methods are relevant, among which coaching can be distinguished. Language coaching is aimed at increasing the productivity of the educator's work, being based on the principles of a person-centered approach.

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SPEECH DEVELOPMENT PECULIARITIES OF PRESCHOOL CHILDREN

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Аннотация. Теоретическии исследованы особенности развития речи у дошкольников. Развитие речи как сложный нервнопсихологический процесс происходит в результате взаимодействия детей дошкольного возраста с окружающей средой.

Ключевые слова: речь, монолог, дошкольный возраст, лексический запас, фонематическое восприятие, языковая деятельность.

Annotation. Theoretical studies of the features of the development of speech in preschoolers are made. The development of speech as a complex neuropsychological process occurs as a result of the interaction of preschool children with the environment.

Keywords: speech, monologue, preschool age, vocabulary, phonemic perception, language activity.

Introduction. An essential aspect for solving the problems of mental, moral education of children in the preschoolperiod is knowledge of the native language at preschool age. Children can interact with the environment by means of speech. Developed speech greatly provides person's interaction with a new team (for example, when entering school, getting closer to unfamiliar children). the ability to clearly express one's thoughts for self-affirmation in a new team is important as well, because this is the key to good academic performance. "The better the person possesses their own speech, the more actively they develop the fields of a certain activity" [1, p. 67]. This is related to preschool age period for "the highest forms of cognitive activity and the capacity for conceptual thinking are being formed at this age along with the development of speech" [1, p. 45]. At preschool age, the circle of communication of children expands.

In addition, "the acquirement of speech skills helps a child to understand, plan and control" [12, p. 307] their behavior. As children become more independent, they move beyond narrow family ties and begin to communicate with a wider range of people, especially with peers. "Speech communication creates the necessary conditions for the development of various forms of activity and teamwork skills" [12, p.307]. But high demands on the development of speech are also made by complicating the activity of the child.

The **objective** of given study is to consider the peculiarities of speech development in the context of preschool age period by means of theoretical methods. We take into account S.L. Rubinstein' point of view that speech is the activity of communication - expression, influence, and message - through

language, speech is language in action. It is a form of existence of consciousness (thoughts, feelings, experiences) for another, serving as a means of communication with him, and a form of social reflection of reality.

The main part. "The child finds a powerful source of intellectual and spiritual formation of personality developing speech, which is necessary condition for the social activity of each person" [1, p. 23]. "Speech is a process of communication, arises and develops under the influence of the need for communication and serves the purposes of public association of people" [12, p.307].

Many scientists studied the issues of speech development: L.S. Vygotskii [1], M.I. Lisina [4], J. Piaget [6], A.A. Leontev [5], Yu.A. Afonkina, G.A. Uruntayev [8]. They suggested that "speech was one of the indicators of a child's development. It fulfills several needs of the child: communicative, informative, cognitive (developing), which already speaks of its great importance" [12, p.307].

Thus, L.S. Vygotskii emphasized that speech as a sign system could transform children's thinking in order to solve problems and form concepts [1]. The development of speech is the basis of communication in the family. "The development of speech is the main means of achieving desires for the individual" [12, p.307]. Features of speech development is a core of the full-fledged formation of the personality of a child - a preschooler, which presents rich opportunities for solving many problems of mental, aesthetic and moral education.

A.N. Leontiev states some stages of speech development: "nursery, which lasts up to a year, preparatory – up to three years, preschool – up to seven years and the school one" [5].Work on the development of children's speech should be comprehensive and solve problems related to all aspects of speech development - phonemic, lexical, and grammatical. A comprehensive influence on the child's speech is a prerequisite for the development of coherent speech.

According to V.P. Glukhov, there is a considerable vocabulary range of preschoolers stage; "by the age of four till six, his vocabulary range already reaches the level of 3000 - 4000 words. At this period, a child uses the meaning of the words correctly" [2, p. 45]. Timely and complete formation of speech at preschool age is a main condition for the general development of the child. They master speech as a means of influencing others and himself, as a means of self-knowledge and self-regulation.

G.A. Uruntayeva pointed out that the child learns to understand the causal relationships. They receive new impressions, their mental abilities forming during the preschool age.The child has a special attention to articulations of others They can make up an end of a story on the proposed

topic [8, 12]. In the process of interacting with the world and the people, the child enriches their experience.

The speech development of children is considered as the ability development to use the language: the development of phonemic hearing, sound analysis, vocabulary, grammatical categories, and the development of communication skills, skills and abilities of coherent speech. Vocabulary increases and children acquire "the basic categories of the grammatical structure. Step by step the skills of word formation are being developed" [7, p.56].

"A coherent speech appears and for this reason the structure of the sentence is getting more complex. Children are relatively free to use the structure of compound and complex sentences" [10, p. 67]. In grammatical structure improvment of the speech of preschoolers, the key task is the formation of language generalizations, which is based on teaching children the independent formation of new words, understanding the semantic shades of the word, as well as using various grammatical structures and ways of connecting sentences in a coherent statement.

Starting from preschool age, "a child could easily make up a retelling of a fairy tale or a story of 40-50 sentences". So, they had already acquired monologue [9].Awareness of the verbal composition of a sentence is the basis for acquiring literacy and consciously operating the language in any coherent utterance.

During the whole preschool period, preschoolers "develop the skill of auditory monitoring over their own pronunciation, the ability to correct it in some individual cases" [12]. The need for communication, the desire to learn, understand something new, the desire to tell about something that encourage the child to actively master the language. The main feature of the development of speech in children at this stage compared to the previous ones is their conscious assimilation. In other words, a phonemic perception or socalled "sense of language" is formed. So, K.D. Ushinskii gave a particular importance [10].Preschoolers freely use the means of expressiveness, are able to adjust the volume of the voice and the pace of speech. The dictionary is actively updated with nouns, verbs, adjectives and adverbs.

A sufficient level of phonemic perception is a condition for mastering literacy in the period of schooling. It allows children to acquire the necessary skills of sound synthesis and analysis. The sound pronunciation of the child is fully formed, and work is underway to improve diction, the ability to correctly use sounds in the flow of speech.

Thus, we can come to **conclusion** that the following speech development peculiarities in the preschool period are: mastering the correct sound design of words, pronunciation of words clearly, vocabulary resources, the expansion of the active vocabulary, the development of skills of phonemic

perception, and mastering monologue and contextual speech. Moreover, children show creative activity: they come up with an ending to the story, a new plot, compose riddles, stage excerpts from works. By the end of preschool age, the child accumulates sufficient reading experience. The skills that encourage better literacy in the period of schooling are being developed. It is clear that preschool childhood is a period of intensive development of communicative forms and functions of language activity, practical speech skills, awareness of speech activity.

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UDC 8001

METHODSAND TECHNIQUES OF INTENSIFICATIONAND MOTIVATION INCREASE IN FOREIGN LANGUAGES LEARNING INTHE CONDITIONS OF MILITARY SERVICE

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Аннотация. Статья посвяшена темеускоренного изучения иностранных самостоятельного языков на примере Проведен обзор методов самостоятельного английского языка. изучения и способов его ускорения, соединяющих в себе высокую эффективность и простоту, учитывающих поведенческие особенности человека и особенности военной службы как курсанта, так и офицера (адъюнкта).Для интенсификации изучения иностранных языков необходима, также, постояннаясамомотивация. В работе представлены практические приёмы использования психологических, образовательных, бытовых и социальных ресурсов с целью стимуляции самомотивации к иноязычному образованию.

Ключевые слова: ускоренное изучение, иностранный язык, методы самостоятельного изучения, способы самостоятельной мотивации, условия военной службы. Annotation. The article is devoted to the topic of accelerated self-study of foreign languages on the example of the English language. A review of self-study methods and ways of its acceleration, combining high efficiency and simplicity, taking into account the behavioral characteristics of a person and the peculiarities of both a cadet and an officer (post-graduate)military service, is carried out. To intensify the study of foreign languages, constant self-motivation is also necessary. The paper presents practical methods of using psychological, educational, household and social resources in order to stimulate self-motivation for foreign language education.

Keywords: accelerated learning, foreign language, methods of selfstudy, self-motivation, conditions of military service.

Introduction

By the end of the twentieth century English had finally acquired the status of a language of global importance. In most schools of the world its study became compulsory, and the methodology of teaching began to develop by leaps and bounds. Not everyone could afford to attend expensive courses, that provoked the emergence of the first methods of English self-study. Subsequently, many authors have attempted to create a program of effective English self-study.

Methods of independent study overview using English as an example The Petrov's method

Dmitry Petrov states that it is possible to learn English in 16 hours. However, the author further specifies that he was not talking about mastery of the language at the level of a native speaker, but about the basic knowledge. His lessons are enough to survive in an English-speaking environment, to explain one's needs and understand the answer, for example, on a special military operation abroad.

Petrov's "Polyglot" method of English has proven its effectiveness in a live broadcast on the "Culture" TV channel. The basis of the method lies in artificial immersion[2] into the language environment. From the first lesson the participants of the show are required to express themselves in a foreign language. To do this, the author gives the necessary lexical minimum on a given topic, as well as models of speech constructions. Most of the class is given just to the repetition [6] of the structures offered, their training, and thus occurs a long-time memorization. This method is solid for learning in a military team environment, requiring only the desire to learn the language and at least one other person who doesn't need to know the language, but at least the alphabet.

The Franck's method

Ilya Frank is the author of the original method of learning English [6], based on reading specially adapted literature. Small portions of a text are

presented with a consecutive translation in brackets. Thus one large sentence is divided into separate phrases, and as soon as the reader finishes reading the phrase, the translation is given in brackets. In this way we can compare the original text and the translation and make up for words we did not know before. After the whole fragment is read in parts with a translation, the same text follows, but without the help of the Russian equivalent.

Using Ilya Frank's method, the students learn the meanings of new lexical units subconsciously, as well as ready patterns of phrases use and construction. The main disadvantage of the method is the accumulation of only passive English knowledge; the adapted texts do not contain exercises for applying the acquired knowledge. Using the methods of learning English by Ilya Frank is worthy when you need additional means of building vocabulary.

This method serves for passive accumulation of vocabulary perfectly. It is enough to read those books for 15-30 minutes before going to bed, in one's spare time or even on watch.

The Umin's method

Publishing his book of "Foreign language easily and with pleasure" [3], Evgeny Alexandrovich Umin (Umryukhin) in 50 pages set forth the method of motor and auditory engrams of uttering and perceiving phrases in English on automatic. The author calls engrams "memory traces", which help the brain to assimilate information more easily. Relying, like Schechter, on the example of children speech training, as well as on his research on the mechanisms of the human brain during learning, Umin has developed a system of daily lessons[1, p. 6]. According to him, by doing just 15-20 minutes a day, one can achieve significant success in a year. If you increase the class to 1-1.5 hours, you can start speaking English at the same level as a native speaker within a year.

In the everyday life of a cadet it is possible to dedicate 15-20 minutes a day to communicate with a classmate only in English. Whether it's on duty or during designated free time.

The Zamyatkin's method

The book "You cannot be taught a foreign language" for many was a revelation. In it Nikolai Fedorovich Zamyatkin reveals the reasons for the unsuccessful teaching of English at school, and also describes the method of "matrix tai chi", which helps to actually learn a foreign language. His methods of learning English are based on gradual immersion in a language environment and creating an artificial "information hunger" – the brain's need for new information [4].According to the method, you need first to listen to dialogues, then read books, and then watch English-language movies. Each step is worked through thoroughly, and it takes 3-5 days to listen to one dialogue in order to understand every phoneme and every word. However,

the author honestly warns that "there is no miracle" -a lot of time and a significant level of self-discipline are required to master the language.

The method is quite demanding and will only suit those servicemen who are given a task to quickly learn a foreign language (for example for a tour of duty abroad), and therefore have the time to complete it. Cadets, on the other hand, can use this method, sacrificing time for self-study.

The Rosetta Stone's method [6]

The last method on our list will appeal to those who spend most of their time at the computer. A specially designed computer flash program gradually immerses the user in a foreign language environment, just as children immerse themselves in the world of adults. The stages are designed with a tendency towards gradual complication, the learner progresses [5] from simple to complex. First the individual simple words are offered for memorization, then the more complex lexemes are given, then the speech constructions are introduced, and then the syntax and grammar are offered.

The presence of a computer is a key difficulty, but those servicemen who have access to it are able to speed up their learning process by taking 30-45 minutes to work.

Techniques of motivation

When starting something new, of course, we want to complete it successfully. But sometimes, after 50-70% of the way, we get tired and lose interest in it. Then we need to motivate ourselves and take strength from somewhere for further action to complete the business at 100%.

These 25 techniqueswill help to bring each started thing to the end. Of course, this is very individual. And what's perfect for some people may not work at all for others. The methods described below are universal. Choose what is relevant to you and apply.

Set priorities. Think about what comes first for you at the moment, what comes second (family, friends, leisure, service...). It is important to understand what your priority in life is for a particular project.

This is a key method from which your planning directly depends: when to serve, when you can rest and relax, and when it is worth it and reach your goals; what is the priority now: grammar or vocabulary; what to do now?

Set goals. Setting goals is not always a simple matter. Remember, goals must be written on paper, achievable, and have a time limit. Identify your intention with one of your set goals.

Highlight milestones. If your language mastery goal is big enough and takes a long time, identify several milestones. This will make it easier for you to summarize and evaluate your productivity.

Ignore the unimportant. Sometimes it seems as if everyone is conspiring to distract us from our goals. A sudden duty. A new task. Endless phone calls. A cold. Military drills...The list goes on and on.

But... We must learn to abstract away everything that doesn't lead us to our current priority goal. Without fanaticism, of course, or we won't have anyone to rejoice in achieving it with.

This means that it is possible to adapt to any inconveniences: to properly distribute the time of the duty, to take small cheat sheets and cards and read them while standing in line in the galley, and in general at any free time, to scroll through in your head while you are going somewhere.

Create the work environment that suits you best. Maybe it's high time you put your desk in order. Or maybe you're missing a picture of someone you love that will inspire you when you look at it. Or maybe you should bring fresh flowers... Think about what kind of environment you need to motivate you.

It would probably be helpful for you to have a reminder of your goals with you in your pocket that you would constantly stumble upon.

Keep a diary of your successes. Write down your accomplishments, even the seemingly insignificant ones. Reread them in a difficult moment and they may be the ones that will keep you going.

Create a notebook with motivational quotes from famous people. Carry it with you and reread it when you especially need help. When you don't have the energy or desire left.

Read biographies of people you respect and want to be like – they will definitely have a positive impact on your self-motivation.

Watch motivational foreign films. If possible, choose to watch films about achieving success, about overcoming difficulties, about success and rewards for hard work and persistence.

It can also be very helpful to watch films that interest you, or to review old ones in the language you are studying with subtitles or without them.

Surround yourself with positive people. Find people who will look at things the same way you do, who will motivate you, and maybe even give you a "magic kick".

It will be easy to make a deal with your fellow, who doesn't need to know languages, he just needs to constantly bother you with questions, like "How's your progress? What have you done so far? Why aren't you learning?" and rightly criticize your idleness.

This is the productivemethod in a military service environment.

Remove yourself from negativity. Don't watch bad news, don't talk to people who have 'it bad'.

Ignore insults, and in general anything that is not directly related to the tasks.

Use your emotions. Laughter is also a good influence. Laugh more often. Stress goes away if you have a good sense of humor [6].

Relax emotionally, joke with your comrades, distract yourself from work from time to time so that you can rest and the studied material can be better assimilated.

Do sports. Physical activity gives discharge. Lead an active lifestyle. Jog, go to the gym or the swimming pool, go skating. Any physical activity promotes the release of endorphins, which give us a feeling of happiness and help us cope with stress and feelings of anxiety.

This is an fficient method in a military service environment.

Reward yourself for success. Reward yourself for completing each phase. Even if it's still a long way to the end of your plan, but you've completed a small stage, it MUST come up with a reward for yourself. It can be a trip out of town, a delicious meal, or even an item you've wanted to get for a long time.

Aim at multiple tasks. Work on several projects at once. You may be more comfortable working on several projects. If one of them bores you, you can switch to another. But in this case there is a danger of starting a new project each time, without having finished any of the previous ones. Limit yourself to 2-3 projects you'll be working on in parallel.

State your aims publicly. Talk about your plans and projects with friends, comrades. This way you will have fewer ways to retreat. You'll have to do it, because otherwise you'll be ashamed in front of everyone who you knew.

This is a suitable method in a military service environment.

Overcome challenges. Take difficulties for granted. When starting a project, always be aware that you will encounter difficulties and obstacles. Don't let them throw you off balance, but let them be seen as part and parcel of the process.

There is a lot of unpredictability in the service environment and it will be difficult to make a clear, straightforward, adequate plan. Take into account all possible crises situations and develop options for this case.

For example: if you find out that you are unexpectedly coming in for duty, you will be ready, you will have cheat sheets and cards, you will know what to do and what you need to do; if suddenly there is an assembly or falling in or an alarm, you will always have materials and sub-tasks for this case with you.

It doesn't matter how slow you go, what matters is that you don't stand still.

Even if you make less being on duty than you would if you were completely free, but the time will not be wasted and you will get closer to your goal, even if just a little.

Have a competition. Compete with yourself or your "competitors". This method is relevant if you want to develop a useful habit. For example, read

15 pages a day. Find a person who also wants to do this. Set a common goal – for example, every other day for a month to discuss and share your progress. Assign a punishment for anyone who misses even one day. It can be material (e.g., buy a comrade an eclair for every time you miss a class) or it can be humorous (do sit downs 100 times while telling jokes).

This is a proficient method in a military setting.

Get rid of fears. If you look at a difficulty through the lens of fear, it magnifies it many times over. It makes your motivation go down as much.

Be determined to get what you want.

Get some fresh air. Your brain desperately needs oxygen. If your workplace doesn't have enough oxygen, your capacity for work drops, and you become drowsy. If you feel overwhelmed, go out to get some air.

Step away from perfection. Do everything well from the first time, but don't try to perfect a certain stage without end. You may never reach perfection, and you will get pretty tired of the project. Go on, even stumbling, without going back for nothing.

Avoid multitasking. If you're really focused on achieving a certain goal and want to bring the plan to its logical conclusion, then don't spread yourself thin.

Involve money. For many people, money is also a motivator. If this is true for you, then imagine how the end of the project will affect your financial situation: how much you get, what you can buy, where you can go. Then you'll want to finish your project sooner.

Think of fame and recognition. For some people, fame and recognition are even more important than monetary rewards. Think about how many people will know about your achievement and how pleased you will be with their admiration [6].

In addition, you are at least justified, and as a matter of fact you will rise in the eyes of comrades, as a person who answered for his words and strives for self-improvement. After all, everyone wants this, but not everyone has the willpower.

Mind public benefits. If the project you are engaged in has nothing to do with material achievements, but is rather a charitable one, then think about the benefit it will bring to many people and how happy they will be when you implement it [5].

This is not a complete list of ways to motivate yourself, but it is enough to get you started. Choose the ways that work for you, and always see things through to the end.

Conclusion

From everything you've read, you can put together a sample method for mastering a foreign language:

You have set yourself a global goal: to master English in a specific scientific direction to translate foreign articles in order to borrow ideas for your theses writing during post-graduate studies [2, 4].

You assessed the knowledge you currently possess: a weak recollection of your high school English course.

You assessed what you need to learn: some sections of grammar, special vocabulary.

You assessed the time needed to reach your overall goal: 3 months.

You divided the global goal into subgoals: to master the construction of sentence types by time, by subordination, by purpose, special turns, and special vocabulary.

You selected methods and techniques suitable for you to intensify and increase motivation guided by this report: the method by Petrov and by Umin, assigned rewards for fulfilling subgoals, state your intention in the company of fellows and bet on your success [1, 3].

You rationed the subgoals by periods: in the first 3 days – master Present Simple, learn 30 words, etc. (when planning, you need to take into account the "inaccuracies", those times and days when you won't work, can't for whatever reason: fatigue, excessive tasks or other top priority things, etc.)

You've prepared a "Plan B" in case of a sudden duty: a shortened plan, just learn 30 words.

You have studied and prepared the material for reinforcement: you have broken down the information into blocks, transferred it to sheets, cards, and slipped it into a pocket of your uniform.

You worked on your plan, step by step, focused on your goal.

You completed the substep (in 3 days): you bought yourself an eclair. If you finished early, you can happily start the next one with the thought of a reward and time to rest.

You have accomplished step by step all the subgoals and they added up to a global goal: you are proud of yourself, you became better, eventually completed your theses and became a PhD with all the bonuses to your salary and living space.

The above described methods of learning English really can help you to learn English on your own, but only up to a certain level. Do not forget that in order to use it effectively you need not only to be able to understand the text and speech by ear, but also to master the speaking skills. And independently determine how well the pronunciation of certain words is almost impossible. It means that the effective learning of English requires at least an interlocutor. But it is better, if this interlocutor can not only talk, but also competently explain incomprehensible details of speech and can act as a mentor, and our teachers of English at the department, cadets and officers of foreign faculty of the naval school will perfectly cope with this task.

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PROFESSIONAL COMPETENCE FORMATION WITHIN A MULTICULTURALEDUCATION

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Аннотация. Целью статьи является анализ ключевых аспектов формирования профессиональной компетентности педагога высшей школы в условиях поликультурного образования.Основными методами в данном исследовании являются анализ научно-методической литературы по педагогике и психологии. Наиболее целесообразным, по
мнению авторов, является введение в изучение всех учебных дисциплин поликультурной информации интегративным путем.

Ключевые слова: поликультурное образование, профессиональная компетентность, педагог, поликультурная компетентность.

Annotation. The subjective of the study is to analyze the key aspects of teacher's professional competence forming in the process of multicultural education. The main methods in this study are the analysis of scientific and methodological literature on pedagogy and psychology. According to the authors, the most expedient is the introduction of multicultural information integratively into the study of all academic disciplines, thereby implementing an interdisciplinary model.

Keywords: multicultural education, professional competence, teacher, multicultural competence,

Introduction. Aneducation teacher's professional competence is one of the key competencies among a teacher's professionally and personally significant qualities necessary for the implementation of effective activities aimed at transferring the culture and social experience from older generations to new ones. Currently, there are a large number of classifications of professional competence components. Thus, the analysis of the works of L.S. Vygotsky [19], S.L. Rubinstein [15], E.A. Klimov [8; 9; 10] and other scientists makes it possible to identify "the following professional competence components: socio-legal competence, that is knowledge and skills in the field of interaction with public institutions and people, as well as knowledge of professional communication and behavior methods; personal competence" [19, p. 6]; auto competence, that is knowledge of technologies for overcoming professional destructions; extreme competence, that is the ability to act in suddenly complicated conditions, in case of accidents, technological processes violations (Vygotsky [19]; Rubinstein [15]; Klimov [8: 9: 10]).

According to J. Raven [14], professional competence is associated with such skills as:" to analyze new situations and apply existing knowledge for such analysis; to work independently without constant guidance; to take responsibility on their own initiative; to take initiative without asking others how to do it; to notice problems and look for ways to solve them effectively" [14, p.12]. These skills acquire anparticular importance in the context of pedagogical activity because the success of innovative transformations in society is directly dependent on a Teacher, without whom it is impossible to imagine the further life path of a person, a future specialist of any professional profile.

The aim of this work is to analyze the concept of a teacher's professional competence which is considered in the context of one's professional activity within a multicultural education. Special attention is paid to multicultural environment issues.

Materials and Methods. The methodological basis of this study is the works of both Russian (L.S. Vygotsky [19], S.L. Rubinstein [15], E.A. Klimov[8; 9; 10], A.N. Dzhurinsky [3], O.V. Khukhlayeva et al [6]), and foreignscientists (L. Gurlitt [5], G. Sharrelmann [17], H.-G. Gadamer [4]and others). Studies of a teacher's professional competence designed to ensure the effectiveness of solving pedagogical, scientific, methodological, organizational and managerial tasks are dedicated to the research of such scientists as: C. Şanli&A.Bostancioğlu [16],I.O.Ibragimov& A.N. Nyudyurmagomedov [7], M.S. Vijay Kumar [18], J. Knight [11], R. J.Marzano, J. S. Marzano&D. P. Pickering [13], H. Walberg [20]and others.

A special role in the analysis of the problem of teacher's professional competence is given to the development of human society cultural heritage as the most important aspect of a teacher's professional competence formation within a multicultural education in the works of such researchers as: C. C. Yeşilbursa [22], E. Yalçinkaya [21], G. Adams & H.R. Markus [1], H.R. Markus & S. Kitayama [12] and others.

Results. Summarizing the approaches of scientists, it can be argued that "pedagogical competence is a process and result of creative professional activity, an integrated indicator of a teacher's personal and activity essence due to the level of one's humanistic and creative orientation realization. Pedagogical activity is complex and multicomponent" [2, p. 10].

The problem of teacher's personality development "within a multicultural professional and educational space which is interrelated with the problem of a preschool and primary education teacher's professional competence, is among the insufficiently developed both in the construction of this phenomenon conceptual models and in the definition of recommendations for existing educational practice" [4, p. 27].

Since the beginning of the XX century, the idea of multiculturalism has been developing in the world which has become a fundamental trend of modern cultural and civilizational development. L. Gurlitt [5], G. Sharrelmann [17] included ethnic and world cultures in this concept which, in their opinion, contribute to the development of universal consciousness and affirm the concept of a single world. «Now 'education' is closely connected with the concept of culture and ultimately denotes a specific human way of transforming natural inclinations and capabilities» [4, p. 27].

The process of interaction within the educational system is connected with culture in its dynamic aspect. Education is a pedagogical process in a multicultural society. "The multicultural educational process encourages, along with the knowledge of someone else's culture, the analysis of one's own culture system"» [4, p. 27].

"In this context, the aim of all educational organizations is not only to familiarize students with different ethnic cultures, but also to teach them to live in a community. Bearing in mind that the process of education includes three components: training, development, upbringing, we consider the process of multicultural education in the aspect of upbringing" » [4, p. 28].

The analysis of modern research in the field of higher education allows to assert: vocational education is creating conditions for the development of a tolerant personality, ready to function in the problems of modern culture who lives and works in a multicultural environment, is attracted to the interpenetration of world and national pedagogical cultures [2, 3, 6,].

Proceeding from this, in the process of educational activity it is possible to implement interdisciplinary, modular, monopredject, complex models of introducing multicultural information into the content of education which can be achieved through academic disciplines, integrated courses, electives, special modules, lesson topics, special techniques, methods and methodological approaches which enhance multicultural specificity.

Purposeful educational work on a person's multicultural competence formation as one of the basic components of a teacher's professional competence should begin as early as possible, at a time when not only a person realizes oneself as a representative of a certain ethnocultural group and systematizes knowledge about other peoples and their cultures, but also when the attitude towards them is realized, their peculiar 'assessment' is formed, and the foundations of a behavioral (life) model for one's own and other ethnic groups are laid.

Conclusion. Thus a teacher's professional competence is a set of structural-forming competencies: subject, productive, psychological, informational, communicative, moral, multicultural ones, as well as competence associated with the teacher's ability to self-development. In the context of multicultural education, a teacher's multicultural competence is of particular importance which implies one's willingness to form such qualities in one's students as: the ability to live in peace and harmony with people of different nationalities, races, beliefs; to build one's life in a multinational and multicultural environment on the basis of mutual respect, mutual understanding and mutual acceptance.

A teacher's professional competence formation within a multicultural education involves the preparation of a highly educated professional, a person capable of creative activity, ready for self-determination and self-realization in professional, social, and personallife spheres, free from negative ethnocultural stereotypes, with the position of a world citizen, a member of the world community, ready to be responsible for the fate of this country and the entire planet.

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PSYCHOLOGICAL FEATURES OF A PUBLIC SPEECH OF A HIGHER SCHOOL TEACHER

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Аннотация.В статье раскрыты вопросы психологии публичного выступления в аспекте ораторского мастерства. Рассмотрен коммуникационный стиль преподавателя высшей школы. Представлены практические рекомендации.

Ключевые слова: психология публичного выступления, стиль, преподаватель высшей школы, коммуникативные навыки, ораторское искусство.

Annotation. The article reveals the issues of the psychology of public speaking in the aspect of oratory. The communication style of a higher school teacher is considered. Practical recommendations are presented.

Keywords: psychology of public speaking, style, high school teacher, communication skills, oratory.

Introduction. Currently, one of the components of the success of life in building a career is negotiating, various communications, and public speaking in front of an audience. Everybody in our lives had to speak to an audience at least once, starting from childhood and throughout our lives. Oral or written communication takes place daily, and a high level of communication skills is the key to personal success, since clearly expressing your thoughts and establishing communication with others is extremely important. Oratory is given to someone as a present, and they have to achieve success through painstaking training, affecting various areas of science, for example, linguistics, logic, philosophy, ethics, master the technique of direct contact, be able to express or hide their emotions [6].

Many scientists analyzed this problem: E.D. Khalmurzieva [10], Dale Carnegie [3, 4], N. Ovcharov [7], P.L. Soper [9], E.N. Kornilova [5]. A.A. Romanyuta, V.A. Ley [8], G.V. Borozdina [2],I. A. Yakovleva [11], R.K. Bozhenkova, N.A. Bozhenkova [1].

E.D. Khalmurzieva studied the oratory of ancient Greece [10]. The social system of Greece was especially favorable for the flourishing of oratory. The theory of eloquence was born on the wide and varied use of practical rhetoric. Teaching oratory was an obligatory stage of ancient education. Even Dale Carnegie considered methods for solving communication problems, new approaches to developing self-confidence, as well as increasing flexibility and overcoming fears [3, 4].

The purpose of this article is present the issues of the psychology of public speaking in the aspect of oratory. The following tasks are given: to consider the communication style of a higher schoolteacher; to statepractical recommendations.

The main part of the study. The term "oratory" (Latin "oratoria") is of ancient origin. Its synonyms are the Greek word rhetoric (Greek "rhetorike") and Russian eloquence. Oratory was a major political force in ancient Rome.

The ability to convince an audience was highly valued by people who were preparing for a political career and saw themselves as rulers of the state in the future. In the middle of the II century BC. Greek rhetoricians appeared in Rome and opened the first rhetorical schools there, young people rushed to them. But Greek rhetorical schools were not accessible to everyone: the lessons of rhetoricians were expensive, and it was possible to study in them only if you knew the Greek language perfectly [11]. Oratory is complex; it is linked with many scientific disciplines and branches of knowledge. But are they enough for complete success in public speaking? No. The old Russian proverb says that "meet by clothes, see off by mind", which has the following meaning: when meeting with a stranger, one's appearance and clothes are first of all striking, they pay tribute to one's mind, knowledge, ability to express thoughts. The first impression of meeting a person does not always coincide with the subsequent assessment of one's merits. Therefore, in the process of communication we have to take into account another important factor - the style one. It is a style factor, which determines the attractive interlocutor's image, and, accordingly, part of the success, as well as audience attention [12].

The person is a huge work and contribution of the speaker oneself, since it is quite difficult to keep the attention of the audience after the start of the speech.

One should consider the psychological methods of influencing the audience during a public speech in more detail.

Speech is one of the leading characteristics of modern man. By the manner of the speaker, one can form a certain picture about the person oneself, one's areas of activity, environment, hobbies, etc. Therefore, it is necessary to master communication skills and deep knowledge in their professional field for the development of a successful person's personality.

One must consider some points of view on the definition of public speaking. Public speaking, also called oratory or oratory, has traditionally meant speaking face to face with a live audience. Today it includes any form of speaking (formal and informal) to an audience, including pre-recorded speech transmitted over long distances using technology. Public speaking is a speaker's speech (mostly a monologue) directly in front of those present. It is a complex concept that combines speaking in front of an audience, in open areas, on television, as well as communication with management, an employer, and just friendly communication in the company of good friends. Knowledge of the psychology of public speaking will be useful in any situation where you need to show your best qualities, demonstrate the ability to communicate, and present your professional skills. A successful oral speech is not just a conversation, but also a signed contract, a new job, business partners, recognition of society. The purpose of public speaking is to interest the audience so that the listeners catch your every word, gesture, and react to the intonations of the voice. This is the ability to inspire people with your ideas.

Cicero said two thousand years ago that any truly good public performance should be excited [11].

It follows from this that it is necessary to prepare for a public speech carefully and in advance. To do this, persons will need to define a topic,

collect information, analyze and monitor it for further writing short abstracts. It will not be superfluous to write a summary of the speech, in which the tasks are highlighted. They will make "speech coherent, logically connected and consistent" [2]. A necessary element of preparation is an assessment of the composition of the trainees and the situation. The speaker must find out in advance what the expected number of listeners is, the social composition of the audience, age, educational and cultural level, and nationality. In some cases, it is religion. It is also necessary to know where the performance will take place in a large hall or a small room, what is the acoustics of the chosen room, whether it will be crowded for the audience.

The audience listens attentively to the speaker - approximately 15-20 minutes in a period. In order not to lose the thread with the audience, the following is necessary. Get in touch with the audience. Everything should happen in the same way as in the dialogue, only the boundaries of the dialogue are extremely expanding.

Just as if in dialogue, you should look at the listeners (listeners should see your eyes!). In your presentation, you have to try to avoid mistakes. Sometimes 2-3 speech errors are enough to form an opinion about the level of the speaker; especially dangerous in this respect are incorrect stresses, which immediately present a person in an unfavorable light. No one can completely avoid slips of the tongue, so minor grammatical errors should not be corrected. "Even the best speakers haveslips of the tongue» [1].

Good speech has ten elements: objectivity, clarity, imagery, purposefulness, emphasis, repetition, surprise, semantic richness, conciseness, and humor [12].

A sustained ability to achieve speaking goals comes with experience. To the question to Napoleon: "How to highlight the most important components of success. Genius? Tenacity? The ability to carry along? He was quick to reply: "Practice, practice, practice!" Having understood the schemes, techniques, techniques that facilitate public communication, a person, through trial and error, gains experience in behavior in various situations. The experience of defeats and victories is the most valuable acquisition for successful publicity. The goal of any speaker is to create a completely individual, special style of speech based on general rhetorical rules [4]. D. Carnegie's golden quote says: "Always stop your speech before your listeners want it. Satiety sets soon after the peak of popularity".

The speech of the teacher is an important element of pedagogical skill, which ensures the fulfillment of the tasks of training and education [13]. Proper command of speech and speech culture increase the demand for a young specialist. Much depends on the professional speech training of beginner teachers, since professions such as "man-to-man" are mainly linguo-intensive, and the activity belongs to the sphere of increased speech responsibility due to constant contact with other people.

The teacher must constantly improve one's speech to ensure effective educational activities. The ability to accurately, competently express one's thoughts, skillfully use terms are the conditions for the formation of speech competence of specialists, but much also depends on the experience of speech activity.

Teachers have to constantly demonstrate pedagogical and oratory skills in the learning process and in front of a large audience with public speech. While speaking to the public, the teacher has a social responsibility for the content, quality of speech, and for its consequences.

One should conclude that speech skill is not just a professional quality, but also an important tool for the activity of a teacher of higher education, which is improved by constant public speaking in front of an audience [8]. Pedagogical speech is a model for listeners. The speech of a wise and authoritative teacher as a text of culture enriches the consciousness of students with new moral values, remains in memory a vivid impression of the harmony of form and content.

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SECTION 9: PHILOLOGY



UDC 372.881.111.1 DIALOGICAL COMMUNICATION PRACTICE (LEXICAL VIEW)

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Аннотация: Статья рассматривает изучение лексического аспекта диалогического общения. Дается определение термина «диалогическая речь». Обосновывается необходимость вступления в диалогический контакт. Определяются психологические аспекты, влияющие на содержание и характер диалогического общения. Рассматриваются такие особенности диалогической речи как эллиптичность с последующей ее классификацией, свернутость синтаксических средств. А также уделяется внимание такой особенности диалогической речи как клишированность. Все эти рассмотренные особенности сопровождаются примерами речевого диалогического общения.

Ключевые слова: диалогическая речь, психологический аспект, повседневное речевое общение, эллиптичность, свернутость синтаксических средств, клише.

Annotation. The paper is devoted to the study of lexical view of dialogical communication. The meaning of the term "dialogical speech" is given. Arguments for starting the dialogical contact are presented. Psychological aspects influencing the content and character of dialogical communication are defined. Such features of dialogical speech as ellipticity with following its classification, relative convolution of syntactic means. Also, the attention is paid to such particularity of dialogical speech as cliché. All these considered features are accompanied by the examples of dialogical conversations.

Keywords: dialogical speech, psychological aspect, everyday speaking communication, ellipticity, convolution of syntactic means, cliché.

The oral communication relates to the most complicated human endeavors and supposes the high level of the verbal aptitude development. Its main unit is considered at the moment the oral dialogical text, i.e. discourse.

The dialogical speech is combination of elocutions joined by contextual thematic relationship and communicative reason which are generated successively by two or more speakers in the direct act of communication.

Making up a dialogue is the process of natural language interaction comprising talk exchanges which do not achieve the monologic speaking range. The term "dialogue" considers both the process of dialogue making up and its result which is the text. The desire to come in dialogical contact relates to the definite reason and the speaking task and while realizing them a speaker's initiativity appears.

The following technological aspects affect both the content and the character of dialogical communication:

1) speech perception of a conversation participant and orientation in the situation;

2) the formation process of pronouncement content part;

3) processes of verbal thinking composition and perception of conversation partner speech.

As well as each conversation participant has to meet a range of mental nature challenges, namely:

1) remember all previous conversations with the certain partner to use in maximum intercommunication and not to repeat oneself;

2) remember all details of a given conversation;

3) assess instantaneously the entire amount of information obtained to the start of speech role;

4) know how to get in a word without violating adopted communication rules;

5) be able to listen to the conversation partner;

- 6) withstand the definite emotional manner of speech;
- 7) observe the correct tongue grammar form of thinking;

8) listen to oneself speech to control its standardization as well as, if necessary, vary the having spoken part of statement correspondent changes or corrections;

9) be able to derive the information from communication situation reporting also by paralinguistic means such as hands and facial gestures.

While studying a foreign language a great attention should be given to the daily speech communication in different spheres of human life activity. Intensification of this process made scientists to develop the scientific foundations of interpersonal speech communication together with simultaneous formation of practical sources including corresponding information. According to the last linguistic practices the language is considered not only as the system of hierarchically organized levels but, foremost, as a wide range of sublanguages or modules each of each in its turn employssystems organization. One of the most (or, perhaps, the most)important modules in the system of any developed language is the sublanguage of everyday communication. Its knowledge includes first of all information about units and their equivalents that form sublanguage, possibility of their employing in contests of different types, limitations imposed on their usage, their potential impact on the communication partner. Knowledge of such a type was traditionally called "linguistic intuition" and was as a rule outside the linguistic description. The contemporary linguistic both included such knowledge into its subject and required their integration into the separate language unitsdescription. Language experts realized the necessity of transition from proclaimatory-based "advices" of lexical-syntax statements formation in everyday communication situations to their more full-scale detailed range. Such statements take one of the central places in personal vocabulary of native speakers and represent some kinds of "building blocks" from which a building of everyday speech is made. It is a product of synchronized oral speech activity of two (three or more) communication participants, i.e. the textual unity which provides all main characteristics of superphrasal uniformity. The parameters of an oral dialogical text can include:

- correspondence to one or another sphere of oral communication;

- thematic character (one topic, the system of topics or some different topics);

- the amount of text producers (dialogue, polylogue);

- functional and style level of discourse (colloquial, official, etc.);

- the level of participants training to speech activity (availability of pro-forma and facts, the level of topic proficiency);

- linguistic characteristics (speech standardization, intonation formation);

- contextuality (the support of speakers on extralinguistic link commands during their speech contact and reflection of such communication feature in text);

- profundity and detail degree of communication topic (or topics) discussed during speech contact development;

text reiteration (incompactness).

A peculiar feature of the dialogical speech as the most distinctive version of the oral type of speech is its ellipticity. Ellipsis, after the statement

of E.A. Semskaja [1], is the omission of an implied linguistic unit in speech or text, structural "incompleteness" of a syntactic construction, a phrase.

After G. Ortner [5] the ellipsis usually resides in the colloquial language for which constructions with "non-substituted" syntactic position are favored. It is characterized with situational speech and non-verbal i.e., nonlinguistic activity during dialogical speech.

As O.A. Lapteva notes [4], even as the speaking language opposes the functional styles of the standard language as an unity, however there are stylistical levels peculiar to speaking. One can differ in ellipsoidal repeats their normativity and stylistic nuances of informal speech such as:

1. Ellipsoidal repeats as natural means for utterances binding and structural expressions of typical reactions.

2. Emphasized brevity and expressiveness of ellipsoidal repeats at the short distance permitting informal communication style.

3. Phenomena that are supernormal: hyperbolic brevity, monosyllabism and repeats as speech abnormality, poor language knowledge and lack of speech culture.

The ellipticity is illustrative for all linguistic levels of dialogical speech: phonetic, lexical, grammatic.

Phonetic ellipsis represents reduction, contraction of phones, e.g. auxiliary verb composes practically one word together with the particle "not" -do not - don't, does not -doesn't, shall not -shan't, I have -I've. The conversational formations such as *course* (of course), *cause* (because), *Twas* (It was), *What d'ye want*? (What do you want?) and others are also relating to this group.

Lexical ellipsis appears while cutting off full words and word combinations abbreviation, like: exam (examination), prof (professor), doc (doctor), fridge (refrigerator), All right (It's all right), etc.

Grammar ellipsis is recognized in dialogical speech both on the morphological and syntactic levels. Morphological ellipsis is omission either of notional verb which is presented by auxiliary one or infinitive part, or omission of auxiliary verb in analytical form. For example: done – have done, had done, is done; going – are going (Where ye going? – Where are you going?); Have a smoke? – Will you have a smoke?; Why didn't you come? You promised do.

Syntactic ellipsis is the typical phenomenon for dialogical speech of any language. Three factors determine it:

1. information transmission by extra speech communication channel;

2. reliance on newly uttered speech works (own and speech partner's);

3. the first and the second factors combination.

1) - Look, Joan. Which wrathful and pretentious. (Mother and daughter are in the zoo staying at the predator cage).

2) - Where are you?

- To the station.
- Why?
- Baggage arrived.

During dialogic communication one can speak for a long time without repeating any full phrase. Some statements are extremely succinct ones. For example: she non, he yes, without, sure thing. Some ellipsoidal statements are widely used in dialogues being factually ready-made language sign: Yes; Of course; All right; Thanks.

The term of syntactic ellipsis also includes omission of structural elements of the sentences: prepositions, conjunction, principal and subordinate parts of the sentences: (It) Must be great to have a sister. (There) Ought to be some milk in the cup. (Are you) Reading? (I am) glad (I) see you.

Some ellipsoidal constructions are reinforced by communication practice and are used as slangs: Thank you; See you later; Nice to see you; Glad to meet you.

The other specific feature of the dialogical speech is relative convolution of syntactic means. For oral dialogues structurally simple sentences consisting of small quantity of words are characterized. A short simple phrase is more convenient for unrehearsed speech. It is distinguished by more mobility. It doesn't overload short-time memory. It allows the speaking person to concentrate on the statement content.

The resort to the other person is natural for the dialogical speech. That's why verbal forms of the second person are widely used in it. It is imperative. (Please, open the door. Will you go to the sea this summer?)

One more feature of dialogical speech is non-normativity (Put on the coat there which hangs). In dialogical speech there are a lot of unfinished sentences, improper beginnigs, double subjects. Statements syntactic structures are simplified. The more the degree of dialogical speech normativity:

1. the more freely situational communication;

- 2. the less educated the speech partner is;
- 3. the less familiar the conversational topic is for him;
- 4. the poorer he knows language;

5. the less elements of automatic reproduction or slangs there are in speech.

The dialogical speech also includes colloquialisms which penetrate even into official, professional functional registers which are used in specific communication situations.

To illustrate abovementioned dialogical speech features one can examine the conversation of English senior schoolgirls according to the topic "Me room": Partner 1: Have you ever...you know...sort of...Mum's said to you, like, could you help me clear up" So you say, Yes, O>K., and put your brother's or sister's away, and then they come up and they say, Where's so and so? – ((Yeah...Yes) – the other partner utterance). But then you think to yourself, well, it's annoying to have ...to have...to leave somebody's coat or something in the middle of the room...

Partner 2: And when they do complain, you fool as it you haven't done your job, but then you say. Well. I did pack it away, isn't it?...you know...

Partner 3: It's annoying as well...

Partner 4: I do the same...I mean it I find anything lying around... if it's no good I gust throw it away...

Partner 1: It might mean a lot...

Partner 4: I think in my family ... I think my mother is the most considerable... She'd ask rather then my father... my father wouldn't...

Partner 1: Well, I'm lucky... I've got a room of my own. So...

Let's examine the character of the language material using in the dialogical speech at the level of sentences that can be classified according to their:

1. communication purpose (declarative, interrogative, imperative, exclamative);

2. syntactic complexity (simple, compound, clause);

3. fullness and complement (unextended, extended and ellipsoidal);

4. the degree of stereotyped expressions (i.e. the readiness of the form to the moment of speech production).

In self-motivated expressions interrogative sentences take part the significant place (up to 40-45 %), then declarative sentences (up to 37 %) and imperative ones (13 %). In the response utterances declarative sentences take the first place (up to 60 %) and interrogative sentences take the second place (20 %).

The simple sentences (70 %) form the basis of the language material the greatest part of which are extended sentences. Compound sentences are applied much less often than simple ones and in general their purpose is to transmit cause-and-effect and conditional-temporal links (by means of objective, conditional and time clauses).

The dialogical speech is characterized by the high level of clichémaking. This term doesn't narrow down to use only the clichés like "Good morning", "Excuses me" or "You bet" but it is about wide use in the practice of dialogical speech so-called made-up signs which are different of speech products constructed at the moment of speaking.

Linguistic units full of clichés is any sign of speech (word combination, sentence) which is repeated in the speech of natives in unchangeable or

partially changeable form and which both expresses a definite meaning and is the level of its resolving.

The origin of speaking cliché as a constant speech sign is seemingly associated with the necessity of speaking partners to express the typical or similar thoughts saying that there is asymbiotic relationship between cliché and repeatability of communication-speech situation.

Clichés are classified as following: cliché – word combination, cliché – sentence, cliché – of under sentence level. The first two types are grouped according to functional community of speaking contact (meeting, representing oneself), using of conversational etiquette rules as well as expressing of standard feelings (astonishment, sympathy, disapproval), communicative narration accompaniment (conversation starting and finishing). Clichés of the undersentence level are grouped according to the community of verbal images.

Any different "made-up" word combinations independently of presence or absence of imagery, idiomaticity, consistency as well as independently of meaning can be referred to speaking cliché. Using various methods of clichés ration determining researchers analyzed a lot of speaking texts and spontaneous discourse of native speakers and drew conclusion of high level of cliché making in speaking text especially in dialogical speech.

After A.B.Krabchenko "sings are cues of some definite character... providing possibility to make conclusion" [2]To such signs one can refer clichés and cliché-made formulas using in the following situations: meeting and waygoing, in responds and after U.B.Kusmenkova the most important for English-speaking social mediumit is supporting the conversation and make good on any partner private space. [3]

One more important feature is detected in dialogue cliché-making. Cliché-making ratio in sentences is higher than that in word combinations. It can be explained by the fact that word combinations or even single words are used in the dialogical speech at the level of sentence (often elliptical ones). But full sentence also can present a cliché. For example:

P 1: What did you think of the film?

PI 2: I like it. I thought it was great.

P 1: Yes, I like it too. Did you like the acting?

P 2: Yes, I thought it was excellent, didn't you?

P 1: Not really. I thought it was disappointing.

P 2: It is a nice cinema, isn't it?

P 1: Do you think so? I don't like it very much.

One can consider such dialogue to be made completely of speaking clichés of the sentence level.

There are some examples of clichés:

Bye-bye

Take care See you later Have a good day Good night Nice meeting you Will you please...? May I ask you to...? Could you do me a favour? Thanks a lot You are welcome What about...? Good luck I wish I could, but... etc.

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UDC 811.161.1/ 378:81'276(075.8) CORPUS APPROACH TO PROFESSIONAL TEXTS TRANSLATION

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Аннотация. В настоящее время необходимо создать связь между цифровым обществом и гуманизацией высшего образования, которая обозначается как цифровая культура. В статье рассматриваются вопросы применения корпусного подхода к решению переводческих задач и трудности обучения переводу в сфере профессионального обшения студентов неязыковых специальностей. Произведен подробный анализ литературы по вопросам перевода текстов различных профессиональных направлений. Авторы отмечают, что при переводе необходимо учитывать культурные особенности страны. Рассмотрены основные проблемы, связанные с организацией обучения переводу. Авторы приходят к выводу, что роль корпусов заключается в предоставлении правильных образцов языковых единиц.

Ключевые слова: перевод, корпус, профессиональные тексты, экономика, юридическое дело, технология, цифровая культура, межкультурная коммуникация, корпус, двухсторонний перевод.

Annotation.Currently it is necessary to create connection between the digital society and the humanization of higher education, which is designated as digital culture. The article examines the issues of application of corpus approach to solving translation problems and the difficulties of teaching translation in the field of professional communication of students of non-linguistic specialties. A detailed analysis of the literature on the issues of translating texts of various professional areas was made. The authors agree that it is necessary to take into account the cultural characteristics of the country when translating. The main problems associated with the organization of teaching translation are considered. The authors come to the conclusion that the role of corpora is to provide the correct examples of language units.

Keywords: translation, corpus, professional texts, economics, legal affairs, technology, digital culture, intercultural communication, corpus, two-way translation.

Problem statement.Digitalization affects not only the economy, the sphere of production and new items consumption. It becomes the basis of culture and changes both this culture itself and the society that surrounds us. We interpret the humanization of higher education as reaction force and one of the beginnings of a digital society and digital culture formation (Kuznetsova, 2019) [9].

The dynamic development of digitalization in all areas inevitably contributes to the constant change in the language media of education. The new learning needs and habits of the "digital generation" are forcing educators[2] and institutions to reorganize educational contexts and digital learning pathways as a resource, to consider and use new learning methods reflected in teaching." Expanding learning opportunities through multidimensional mobility provides the possibilities diversification of learning processes by means of acquaintance through communication in different contexts, among people and interactive technologies. It is no longer a matter of integrating technology into the learning process; it is about integrating the learning process into everyday use of technology"(Lazovic Milica, 2021) [10].

"The educational process is learning, communication, where there is controlled cognition, assimilation of social and historical experience, reproduction, mastery of one or another specific activity that underlies the formation of personality" (Sokolov, Mikhaylova, 2020) [18]. Professional communication "for work purposes is framed by various professional environments and the role of translation differs not only among various professional settings but also within their individual vertical structures" (Chroma, 2014) [5, p. 147].

A. Negoescu studies aspects of advertising discourse. On her mind, "the words are very carefully chosen to create something unique, surprising and memorable in order to achieve the most impact upon the audience" by means of different linguistic techniques at different levels to be persuasive: phonetics, lexical and morphology, semantics and pragmatics (Negoescu, 2011) [15]. F. Rahimi emphasizes that English textbooks must take into consideration students' needs, lifestyles, culture, values, and rituals. "For the development of more culturally-bound, context-specific materials, it is desirable to have local, rather than globally-recognized, syllabus designers and material developers involved in the process of writing, designing, and developing EFL materials" (Rahimi, 2011) [16].

Linguistic corpus, and methods of teaching foreign languages were studied by P.V. Sysoev (2020) [19], Qingshun He, Bingjun Yang (2018) [8]. The methods, theory and practice of corpus linguistics, as well as the theoretical foundations were considered by M. Baker (1999) [3], T. McEnery, R. Xiao, Y. Tono (2006) [11], D. Biber, S. Conrad, and R. Reppen (1998) [4]. The issues of language teaching and translation based on parallel corpora are given great attention in the works of such scientists as K. Aijmer, B. Altenberg, M. Johansson (1996) [1]. L. Shuangling (2019) studied legislative language as a subtype of legal discourse using a corpus approach.

Q He, B. Yang (2018)[8]conducted a corpus study of the relationship between formality and typical metaphors in English texts. Chul-Kyu Kim (2009)[6] characterizes a corpus as a cross-cultural textual analysis of relationships in a text. Konul Hajiyeva (2015)[7] investigated the role of corpora in improving the efficiency of students learning vocabulary in an academic environment. The corpus approach in discourse was studied by Á.Z. Tejada, C.N. Gallardo, C.M. Ferrada, I.C. Lopez (2015) [20]. So, T. McEnery, R. Xiao, and Y. Tono (2006)[11] studied the use of quantifiers in economic texts in the German-Spanish corpus, compiling a comparable corpus of sixty specialized online newspaper articles (CrisCorp).

2. The purpose of the article

Language is considered to be an essential part of our understanding of the world as it provides interaction between humans. Culture, science and religion depend on language. The barriers among them are to be diminished by means of the translations. In this article, the issues of application of corpus approach to solving translation problems are studied.

3. Presentationofthemainmaterial

Translators need in resources to determine factors that influence on the translated text quality. "Special characteristics presence in the texts that characterize the units of a foreign language text is the main feature of language corpora. The main role of corpora is to provide the most correct examples of the use of language units that reflect both the complexity and features of the natural language" (Mikhaylova, 2020) [12,p. 361].

"Translation of professional texts from English plays a special role in the current foreign policy situation, and mastery of foreign languages skills implies the comprehension of its functioning in a variety of speech realizations within the framework of socially significant situations, mastering pragmatics of speech through the system and norm of the language" (Mikhaylova, 2021) [14, p. 414].

The translation should be free of alien to modern literary language elements, including professionalisms, since language is a harmonious system of means of communication which becomes speech. One is subject to various influences, in particular speech and <u>cultural</u> impoverishment, that<u>anyone</u> can <u>readily</u> understand.

One should remember that to denote new concepts, innovative words were formed or changed their stylistic coloring; some words have been enriched with other semantic means; restricted words appeared. "The formation of the vocabulary of the English language was affected by historical developments" (Mikhaylova A.G., Dyachenko, 2021) [13, p. 371].

While translating the maritime text one should take into consideration that "the English language borrowed foreign words in the conditions of the colonial activity and commercial expansion of the British themselves. Borrowing is the result of a process historical change due to the enrichment of words from Scandinavian, Latin, French, Greek and Italian (Mikhaylova A.G., Dyachenko, 2021) [13, p. 372].

Corpus linguistic approaches are more integrated with other methodologies used in applied linguistics. There are many means to define a

corpus. Scientists define a corpus as a machine-readable authentic texts collection.

Another feature of the corpus is a fundamental collection of texts available for qualitative and quantitative analysis of the translated material.

A recently developed Specialized 8 Million Civil Engineering Research Paper Corpus (SCCERA) developed at the University of Tokyo is presented.First, a keyword analysis was carried out to identify words associated with civil engineering academic articles with potential pedagogical value. Today, national linguistic corpora have emerged that include a variety of genres and registers, such as Bank of English (200 million word usages), British National Corpus (100 million word usages).

There are specialized corpora that represent both written and oral academic speech, such as

- Cambridge and Nottingham Corpus of Discourse in English,
- Corpus of Spoken Academic English,
- Michigan Corpus of Academic Spoken English,

- Cambridge International Corpus (materials became the basis of the grammar of spoken and written English «Cambridge Grammar of English»).

While corpora have been widely used to provide more accurate descriptions of language use, a number of scholars have used corpus data to critically analyze existing English as a Foreign Language (TEFL) curricula and materials (McEnery, Xiao, Tono, 2006) [11].

The corpus method has changed the approach of scientists to the study of vocabulary. In corpus research, vocabulary is usually divided into 20-25 registers of 1000 words. BNC lists provide more detailed estimates of the vocabulary of texts because they cover a huge number of word sets. In order to identify the most valuable and frequently occurring words in academic contexts, various vocabulary lists were compiled from corpora. As corpus research became available, faculty researchers tried to assemble corpus learning material that could help students in any discipline, focusing on the lexical items in the subject being studied.

There are two types of parallel corpora in modern corpus linguistics:

1) multilingual (Comparable (Multilingual) Corpora),

2) translation (Translation Corpora).

The structural organization of the corpus may consist of: a traditional text with reference to translations, a tabular form, which is more convenient for perception and comparison, a database. Projects of electronic text corpora are actively developing and have significant applied potential in the methodology of teaching foreign languages and translation.

An electronic specialized corpus of texts in English in the translation of military texts makes it possible to find a way to eliminate errors in the use of lexical and grammatical compatibility. The corpus approach is a way of solving the difficulties associated with choosing the optimal grammatical structure.

The use of corpora in the process of translating military texts makes it possible to realize professionally relevant aspects of foreign language proficiency. For example, the purpose of the corpus in elective English courses for future military translators is to focus on lexical units. Also, these corpora can be used to build and clarify grammatical phenomena.

Corpuses allow to select possible equivalents of the studied vocabulary, trace its meanings and functions in contexts. A distinctive feature of professional translation is its high terminology. The textsare full of terms, i.e. in such words that have an unambiguous interpretation in a given situation. The term can receive a specific interpretation in dofferent spheres. Corpusbased lexicographic analysis clearly helps to reveal the contextual use of certain words, especially synonymous ones (for example,installation, facility; to supervise, monitor, check, verify, regulate, audit, control, or command, control, supervision), their regularity in certain styles, frequency compatibility with other words and clearly define their semantics.

One of the didactic properties of a linguistic corpus as a system of texts is the contextuality of the search results, namely, when you search for a certain word in the corpus, the concordance program (concor-dancer) or the corpus manager provides several options for using this word in contexts in the original language with possible ones in the translated language.

Conclusion. Within the framework of the linguistic theory of translation, the concept of adequacy is considered as the main criterion for the quality of translation. The adequacy of the translation is exhaustive accuracy in the transfer of the semantic content of the original and a full-fledged functional and stylistic correspondence to it. This correspondence is established between two languages, one of which is conventionally called source language, and the other – translated language. The achievement of adequacy is associated with the concept of equivalence.

From the point of view of stylistic specifics, there are significant stylistic differences between the texts of processional subjects. The main role of corpora is to provide the most correct examples of the use of language units that reflect both the complexity and features of the natural language. The use of corpora in the process of translating texts makes it possible to realize professionally relevant aspects of foreign language proficiency. The corpus presents the features of word usage in real language situations as well.

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SOLVING TEXTUAL PROBLEMS BY AN ANALYTICAL MODELUSING THE OPERATIONS OF A SYSTEM OF LINEAR ALGEBRAIC EQUATIONS

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2nd-year student of the Accounting, Analysis and Audit Specialty FSBEI HE "Kerch State Maritime Technological University" Аннотация. Рассмотрена математическая модель системы линейных алгебраических уравнений для решения текстовой задачи из сборника Л. Кэрролла «Рассказы с узелками», а также

проанализированы протекающие операции, обеспечивающие нахождение наиболее простого и эффективного способа решения задачи.

Ключевые слова: модель системы линейно-алгебраических уравнений, комплекс методов решения, производительность труда, эффективность выполняемых операций.

Annotation. A mathematical model of a system of linear algebraic equations for solving a text problem from L. Carroll's collection "Stories with nodules" is considered, and the flowing operations that ensure finding the simplest and most effective method of solving the problem are analyzed.

Keywords: model of a system of linear-algebraic equations, a set of solution methods, labor productivity, efficiency of operations performed.

Introduction

Mathematical science is amazing. The variety of forms and methods of solution is striking in its vastness and uniqueness. Solving various problems is a kind of art, because you can come to the same answer in completely different ways [4, 5]. In this paper, we have considered the solution of one example from L. Carroll's book "A Tangled Tale". Taking the author's reasoning and research as a basis, new solutions were derived and an analogy was drawn with L. Carroll's original solutions. Instead of the traditional analytical method of solving text problems, we decided to resort to the method of converting the condition into a system of linear-algebraic equations [1, 2]. A number of generalizing designations were introduced, which made it possible to optimize the decision process and come to the right decision, while spending less effort [3].

Purpose: to study the text problems of the collection "A Tangled Tale" by L. Carroll.

Task: To propose our own alternative method of solving by performing various operations of systems of linear algebraic equations and using computer technology.

Knot No. 6. Task 2.

Lolo (L) manages to knit 5 scarves in the time while Mimi (M) knits 2. Zuzu (Z) manages to knit 4 scarves in the time while Lolo knits 3. Five Zuzu scarves weigh the same as one Lolo scarf. Five Mimi scarves weigh the same as 3 Zuzu scarves. One Mimi scarf warms as well as 4 Zuzu scarves, and one Lolo scarf warms as 3 Mimi scarves [6].

Which of the three knitters is better if the speed of knitting, the lightness of the scarf and its ability to retain heat are evaluated equally?

Decision.

One should introduce our own letter designations. Let the scarves knitted by knitters have the following designations: x - scarves knitted by Lolo; y - scarves knitted by Mimi; z - scarves knitted by Zuzu.

One should consider the condition in the form of several systems of linear-algebraic equations.

1){
$$5x = 2y4z = 3x 2$$
}{ $5z = x5y = 3z 3$ }{ $y = 4zx = 3y$

One solveeach of the systems by the Jordan-Gauss method. should 1)We bring the extended matrix of the system to a stepwise form:

 $\underbrace{ \begin{cases} 0 & 5 & -2 & 0 \\ 4 & -3 & 0 & 0 \\ \end{array} }_{\Xi} \underbrace{ \left[\begin{pmatrix} 4 & -3 & 0 & 0 \\ 0 & 5 & -2 & 0 \\ \end{array} \right] }_{L_{2} \leftrightarrow L_{1}} \underbrace{ \begin{pmatrix} 4 & -3 & 0 & 0 \\ 0 & 5 & -2 & 0 \\ \end{array} \right] }_{L_{1}/(4) \rightarrow L_{1}} \underbrace{ \begin{pmatrix} 1 & -\frac{3}{4} & 0 & 0 \\ 0 & (5 & -2 & 0 \\ \end{array} \right] }_{\Xi} \underbrace{ \left[\begin{array}{c} 0 & 0 & 0 \\ 0 & (5 & -2 & 0 \\ \end{array} \right] }_{L_{2} \leftrightarrow L_{1}} \underbrace{ \begin{pmatrix} 1 & 0 & -3 & 0 \\ 0 & 5 & -2 & 0 \\ \end{array} \right] }_{L_{1}/(4) \rightarrow L_{1}} \underbrace{ \left[\begin{array}{c} 1 & -\frac{3}{4} & 0 & 0 \\ 0 & (5 & -2 & 0 \\ \end{array} \right] }_{L_{2}/(5) \rightarrow L_{2}} \underbrace{ \left[\begin{array}{c} 1 & -\frac{3}{4} & 0 & 0 \\ 0 & (1 & -\frac{3}{4} & 0 \\ \end{array} \right] }_{L_{1}-\left(\frac{-3}{4} & -\frac{3}{4} & 0 \\ \end{array} \right] }_{L_{1}-\left(\frac{-3}{4} & -\frac{3}{4} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 1 & -\frac{2}{5} & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}[\begin{array}[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}[\begin{array}[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}[\begin{array}[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 0 \\ \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}[\begin{array}[\begin{array}[\begin{array}{c} 1 & 0 & -\frac{3}{10} & 0 \\ 0 & 0 \end{array} \right] }_{L_{2}} \underbrace{ \left[\begin{array}[\begin{array}[\begin{array}[$ $\begin{cases} z & -\frac{3}{10} \cdot y = 0 \\ x & -\frac{2}{5} \cdot y = 0 \end{cases}$ (1)

From equation 2 of the system (1) we find the variable x: $x = \frac{2}{r}$. From equation 1 of system (1) we find the variable z: $z = \frac{3}{10}$. **Answer:** $z = \frac{3}{10} \cdot y; x = \frac{2}{r} \cdot y; y = y.$

2) We bring the extended matrix of the system to a stepwise form:

$$\begin{pmatrix} 0 & -1 & 5 \\ 5 & 0 & -3 \\ \end{array} \begin{vmatrix} 0 \\ 0 \\ 0 \\ -1 \\ z_2 \leftrightarrow L_1 \end{pmatrix} \begin{pmatrix} (3) & 0 & -3 \\ 0 & -1 & 5 \\ 0 \\ z_1 \land (5) \rightarrow L_1 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ 0 & -1 \\ z_1 \land (5) \rightarrow L_1 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ 0 & -1 \\ z_1 \land (5) \rightarrow L_1 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ 0 & -1 \\ z_2 \land (-1) \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \rightarrow L_2 \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \land (-1) \land (-1) \land (-1) \land (-1) \land (-1) \end{pmatrix} \begin{pmatrix} 1 & 0 & -3 \\ z_1 \land (-1) \land ($$

From equation 2 of the system (1) we find the variable x: x=5zFrom equation 1 of system (1) we find the variable y: $y=\frac{3}{5}z$.

Answer: $y=\frac{3}{5}$ ·z; x=5z; z=z.

3) We bring the extended matrix of the system to a stepwise form: $\begin{pmatrix} \circ & 1 & -4 & | & \circ \\ 1 & -3 & \circ & | & \circ \end{pmatrix} \xrightarrow{\sim}_{L_2 \leftrightarrow L_1} \begin{pmatrix} 1 & -3 & \circ & | & \circ \\ \circ & 1 & -4 & | & \circ \end{pmatrix} \xrightarrow{\sim}_{L_1 \to L_1} (3) \xrightarrow{\sim}_{L_1 \to L_2 \to L_1} \begin{pmatrix} 1 & \circ & -12 & | & \circ \\ \circ & 1 & -4 & | & \circ \end{pmatrix}$ $\begin{cases} x & -12 \cdot z = 0 \\ y & -4 \cdot z = 0 \end{cases} (1)$

From equation 2 of the system (1) we find the variable y: y=4zFrom equation 1 of system (1) we find the variable x: x=12z

Answer: x=12z; y=4z; z=z.

Next, L. Carroll suggests multiplying, and not adding up the estimates of the applicants. To do this, we will again compile a system of linearalgebraic equations, taking the productivity of each knitter as 1.

$$\{\frac{2}{5}y * 5z * 12z = 1\frac{3}{10}y * z * z = 1y * \frac{3}{5}z * 4z = 1\{24yz^2 = 1\frac{3}{10}yz^2 = 1\frac{12}{5}yz^2 = 1$$

Comparing all the values obtained, we can conclude that the places in the competition are distributed as follows: 1) Mimi, 2) Lolo, 3) Zuzu.

Conclusion: After reviewing the materials of L. Kerrol's collection "A Tangled Tale", we derived our own solution of these problems using systems of linear algebraic equations and computer technologies using the Jordan-Gauss method and the Gauss-Bareis (Montante) method.

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