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В сборнике содержатся материалы докладов, рассматривающих теоретические и практические вопросы инновационных технологий, проблемы сохранения культурной памяти, истории, экологии, филологии, педагогики, психологии и др.

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THANK YOU FOR YOUR PARTICIPATION!

SECTION 1. ENGINEERING INNOVATION PROCESSES

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METHODS FOR IMPROVING THE QUALITY OF ELECTRIC POWER IN THE UNIFIED MARINE POWER SYSTEMS

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The production of high-power frequency converters, screw-rotor columns, and rowing systems such as Azipod have substantially increased the quality characteristics of rowing electric systems (RESs). At present, RESs are used on most types of ships. The electric-power systems of modern ships with electric propulsion are constructed as unified ship power systems that provide power supply to both the RES and numerous general ship consumers. The advantages and drawbacks of three versions of UMPSs have been considered in [2]: a UMPS with a transformer in the composition of the RES, which is widespread on ships, a UMPS produced by Waertsilae Ship Power Corp., and a UMPS proposed by St. Petersburg State Marine Technical University [3]. It has been shown that the quality of the feeding voltage of rowing electric motors and that of general ship consumers are almost the same. However, the two latter variants of UMPSs make it possible to do without including a transformer in the RES and, as a result, to reduce the cost, mass, and dimensions of the electric equipment of a ship, to decrease fuel consumption, and to free up space in the ship.

It should be noted that rapid and radical changes associated with improving and using rowing electric systems have taken place in

shipbuilding in the last 20 years. To control ac rowing motors, high-power frequency converters were developed in these years, with screw-rotor columns and the Azipod rowing system being produced. These achievements substantially increased the qualitative characteristics of RESs and allowed them to change propulsive systems with a heat engine directly connected with the screw propeller. In comparison with other types of propulsive systems, modern RESs have a number of advantages:

   − increased reliability of a ship's electric-power equipment and propulsive system;
   − improved ship maneuverability;
   − increased efficiency of power equipment in shared modes;
   − low levels of noise and vibration;
   − decreased operational expenses;
   − decreased repair time of repair; and
   − the possibility of more efficient arrangement of onboard equipment.

Due to their unique properties, RESs were briefly widely used on ships of various types: cruise liners, ferries, container ships, tankers, fishing boats, tugboats, refueling ships, etc.

The power systems of modern ships with electric propulsion are constructed as unified systems that supply the RES, as well as numerous general ship consumers. The structure and parameters of the UMPS affect the cost of designing and shipbuilding; the lifetime of electric equipment and automation systems; commercial indices of ships during their operation, such as fuel consumption; navigational safety; and crew working conditions.

It is a serious problem when designing UMPSs to provide electromagnetic compatibility of the general ship consumers and the RES, which is a nonlinear load for a ship's electric powerplant. According to the requirements of the *Russian Maritime Register of Shipping* [1], in a fully equipped electric-power system, the coefficient of a nonsinusoidal voltage curve should be no higher than 10%.

Many shipbuilding companies use the structure of a UMPS with transformers in the structures of RESs, in which the problem of electromagnetic compatibility has been quite successfully solved.

The development of perspective UMPSs with electric propulsion leads to the necessity of generation and transformation of electric power for RESs using modern semiconductor converters and providing reliable operation. Instead of the earlier available so-called "interference of the harmonic composition of voltage," in a UMPS, the harmonic composition of voltage in the electric circuit is summed. This is the main difference of the problem

that has been laid out from that in numerous works on improvement of the harmonic composition in general and autonomous energetics.

To design a UMPS, a systematic approach taking into account the requirements of normative documents is necessary. In addition to limitations on the quality of electric power, other requirements (reliability, mass and dimensional, electromagnetic compatibility, thermal losses, etc.) come into effect according to these normative documents. Furthermore, several characteristics should be used.

When designing a UMPS, it is desirable to obtain the minimum harmonic composition thanks to relatively cheap methods of electric-power conversion (the use of a diode rectification bridge, pulse-width modulation (PWM) for control systems, a multilevel inverter, splitting of windings, etc.). Filters, including active filters, should be used last of all.

In the general case, the harmonic composition of current and voltage is affected by the following factors:

– the parameters of the generator;

– the power of the equivalent asynchronous load;

– the presence of conventional filters and filtercompensating devices and their parameters;

– the use of active filters;

–the use of pulse-width modulation in static semiconductor converters (SSC);

– the use of multilevel converters;

– the number of phases in the electric propulsion system;

– the type of an electric motor of the electric propulsion system (synchronous, asynchronous, ac converter feed).

As the experience of designing and performance of UMPSs has shown, general ship consumers use from 10 to 20% of power depending on the operational conditions. However, the use of powerful static converters in the electric propulsion system of other consumers causes to create the output voltage in a new way when ensuring quality of electric power.

It is known that the static converters generate higher harmonics into the main, and their negative effects are well-known: a decrease in the efficiency and torques of electric motors, increased heating of system elements, and faults in systems of control, communication, etc. If a typical structural diagram is considered (Fig. 1), it is seen that a sinusoidal behavior of current and voltage should be provided at the main distribution board (MDB), as well as in the electric propulsion subsystem.

The parameters of the circuit (Fig. 1) are as follows.

$S_{G1} = 3000$ kW, $x_d^{''} = 0.13$, $S_{AM3} = 10\%$, $S_{REM4} = 50\%$, $S_{SL5} \approx 10\%$.

$S_{G2} = 3200$ kW, $x_d'' = 0.32$, $S_{AM3} = 10\%$, $S_{REM4} = 50\%$, $S_{SL5} \approx 10\%$.
$f$invPWM = fDC-DC = 2000 Hz.
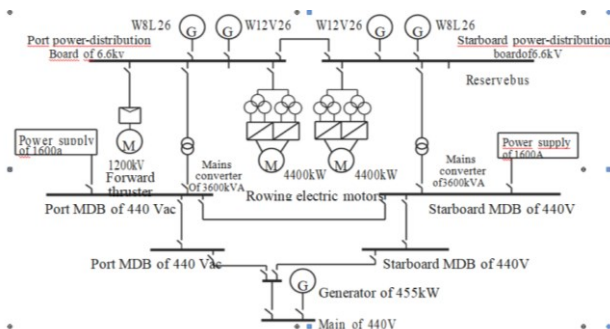
Figure 1 – Structural diagram of the UMPS with two electric circuits.

One should consider some of the aforementioned factors in detail. For typical generators, the main parameter that affects the harmonic composition of voltage across the MDB is subtransient inductance x_d. A decrease in this inductance approximates a real power supply to an infinite power supply. For ship generators, resistance x_d ranges from 0.11 to 0.32 relative units. The influence of subtransient generator inductance x_d and type of a voltage inverter across THD_U and THD_I in the considered circuit is shown in Table 1.

Table 1. Methods for improving electric-power quality in ship systems

Place in diagram	Parameter	Two-level inverter				Three-level inverter			
		with a filter	without a filter	with a filter	without a filter	with a filter	without a filter	with a filter	without a filter
		$x_d''=0.13$		$x_d''=0.32$		$x_d''=0.13$		$x_d''=0.32$	
		Total harmonic distortion (THD)							
MDB	Ua1	7.48	8.618	14.91	14.610	8.699	8.619	15.21	15.11
	Ia1	13.04	13.893	10.20	10.314	13.059	13.012	10.03	10.01
After inverter	Uainv	72.92	69.743	69.477	69.877	31.20	30.98	30.95	31.01
	Iainv	7.02	6.742	6.13	6.975	5.07	5.10	4.97	5.13
At REM$_4$	Ua4	2.48	69.743	8.78	69.877	6.68	30.98	7.23	31.01
	Ia4	1.72	6.742	2.42	6.975	4.81	5.10	5.03	5.13

It should be noted that a substantial decrease in the subtransient inductance increases the short-circuit current, i.e., complicates operation of electric protection in the system. Moreover, the transition to increased

voltages of 6.3 and 10.5 kV does not cancel the necessity to increase the subtransient inductance of ship generators with the aim to limit short-circuit currents.

The next factor is the power of the equivalent asynchronous load. It is known that this load has a stabilizing effect on the quality of electric power. As was mentioned, the power of an asynchronous load in a UMPS ranges from 10 to 20% of the total system power. Therefore, its influence on the decrease in a harmonic composition will be slight. It can affect harbor modes when using standby generators.

Filters and filter-compensating devices have been used for a long time both in autonomous energetics. These devices are generally reliable and easy to produce and operate. Their main drawbacks are extra mass and dimensions, additional losses, and possible resonance phenomena at certain frequencies.

An increase in the number of system phases allows one to improve the quality of electric power. This can be provided either directly in the power supply, which is undesirable for marine systems in the general case, or by using transformers. In the latter case, the design of a transformer is substantially complicated and total symmetry of phases can hardly be provided.

Electric motors are power consumers and react to the harmonic composition of voltage (current) in a different manner. If synchronous and asynchronous machines consume sinusoidal current, the phase of an ac converter-fed motor requires pulse current, which can be an additional source of higher harmonics.

Pulse-width modulation is used to control output voltage in frequency-conversion systems with a dc link, as well as to improve the harmonic composition of output voltage in the frequency convertor. It can be concluded that, in the given rage of considered powers and at given parameters of filters, an increase in the clock frequency of PWM up to 2000 Hz leads to improving the harmonic composition of voltage and current at all stages of voltage conversion (MDB, inverter, REM). Further increase in the clock frequency does not affect the considered quality indices of power.

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Аннотация. В настоящее время широкое распространение получили унифицированные электроэнергетические системы с использованием многоуровневых преобразователей, систем Azipod, различных типов винто-роторных колонн и новых типов электродвигателей. Эти энергосистемы позволяют обеспечить высокое качество потребляемой мощности, а также повысить надежность и маневренность морских судов. В статье рассмотрены требования к современным унифицированным электроэнергетическим системам и методам управления параметрами электроэнергии.

Ключевые слова: судовые энергетические системы, качество электроэнергии, преобразователи, гребной электродвигатель (ГЭД).

Annotation. At present, the unified electric-power systems using multilevel converters, Azipod systems, various types of screw-rotor columns, and new types of electric motors have become widespread. These power systems make it possible to provide high quality of consumed power, as well as to increase the reliability and maneuverability of marine vessels. In this paper, the requirements for modern unified electric-power systems and the methods to control electricity parameters have been considered.

Keywords: unified marine power systems, quality of electric power, converters, rowing electric motor (REM).

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INTRODUCTION OF BIOMETRIC ELEMENTS INTO ACCESS CONTROL SYSTEMS

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Introduction. Access control system (ACS) is a set of technical means aimed at controlling the entrance and exit to a room in order to ensure security and regulate the visit to a certain object.

The main tasks of access control systems are:
– access to the premises of a certain group of persons;
– control of the working day;
– ensuring security.

To confirm the identity of the access subject, you can use knowledge (passwords), attributes (card, keychain) and personal characteristics.

For several decades now, various card products have been the main means of identification. These can be contact and contactless cards of various formats and standards, QR (two - dimensional) and barcodes on various physical and electronic media, and even smartphones with a built-in NFC chip. The widespread use of such identifiers is primarily due to their low cost, as well as their versatility — access cards are easy to add to any existing ACS.

However, there are a number of drawbacks: the identification function is conditional; the possible fact of substitution of the actual user is ignored; there is a technical possibility of cloning them.

The disadvantages of the card ID-based access control system can be eliminated by combining the reader with biometric terminals. However, biometric ACS are still rare, mainly used systems with the determination of fingerprints, geometric parameters of the hand, eye, actively developing technologies using analytical video surveillance.

Materials and methods. One of the most interesting options for combining the attributive and biometric method for the ACS is the development of the Zwipe matching. Physically, the new device is the size and shape of a matching, but has a built-in fingerprint scanner. The principle of operation of the Zwipe matching is as follows: the user applies a pre-stored finger to the scanner, which activates the corresponding transponder built into the matching, and presents the analysis result to the reader (figure 1). Data exchange between the matching and the reader is only possible when the user's fingerprint matches the recorded pattern. The mapping takes place directly in the matching itself using the 1:1 method (this is the reason for the high speed, which does not exceed 1.5 seconds). The matching is one — time, i.e. it is impossible to overwrite the fingerprint or modify it in any other way. Thus, the user, and most importantly the owner of the ACS, can be absolutely sure that the loss of the ID will not lead to unauthorized use by third parties [3].

The basic feature of the Zwipe products, in addition, is that in the standby mode (i.e., when the finger is not present on the scanner), it is not possible to receive the transponder response from the outside for subsequent cloning. Such cards can be used with any ACS technologies, such as EM-marine (which does not contain any cryptographic protection

tools at all), and DESFire EV-1 (the most secure contactless standard to date). To ensure compatibility, you need to choose a model with a transponder similar to the one already used on the object. It turns out that the developers of Zwipe managed to preserve all the advantages of card products, while eliminating the unreliable subtleties from the point of view of the bandwidth mode.

Figure 1 — Example of a Zwipe card

The owner of the system will also don't have any problems with the protection of personal data. The finger recording process is performed by the user, not by the system administrator, using the card itself. Even theoretically, fingerprint data cannot be transferred to third parties. The issue of hygiene is also solved by itself.

Results. We suggest using this principle of connecting biometric sensors with existing ACS systems, but we use devices that are in the pocket of literally everyone — smartphones (figure 2). They are already equipped with fingerprint sensors and face recognition systems. Accordingly, we can use the information from the security system of the smartphone (identification of the owner) to transfer to the external ASC.

One should consider a possible implementation of such a system.

Figure 2 — Smartphone fingerprint reading

The most common fingerprint scanners currently available are stated to be capacitive scanners (figure 3). They are placed on the front and back of the smartphone, as well as as part of the built-in display module [2].

Figure 3 — Face scanning with a smartphone

Capacitive capacitors are more resistant to dummy prints. Capacitors accumulate an electric charge, and connecting them to conductive plates on the surface of the scanner allows them to be used to recognize the details of a fingerprint. The accumulated charge will change slightly where the tip of the finger touches the conductive plates (the ridges of the fingerprint). The air gap between the ridges will leave the charge of the capacitor relatively unchanged. The more capacitors, the higher the resolution of the scanner. To read these changes, an analog integrator is used, and then they can be recorded by an analog-to-digital converter. This digital data can be analyzed to find unique fingerprint attributes. They can then be saved for comparison in the future. The results cannot be reproduced as an image, but we can receive them as a signal and send them to the ACS.

The second option we can use is face recognition.

The operation of the face recognition system in smartphones can be divided into four stages:

Face scan. It is carried out using a front-facing camera or a special sensor. The scan is three-dimensional, so the photo display will not work.

Extract unique data. The system focuses on a set of features of the scanned face. These are the contours of the eye sockets, the shape of the cheekbones and the width of the nose, individual features can be used.

Retrieving a template with previously received data from memory.

Search for matches. The final stage where the system decides whether to unlock the display. The power of modern processors allows you to spend a fraction of a second on the comparison.

Accordingly, we can get the result of the analysis for use in the ACS. To transmit this information to the system reader, we use the Near Field Communication (NFC) technology or "near field communication" (figure

4) — a method of wireless data transmission over a distance of up to 20 cm [1].

Figure 4 — Example of an NFC module

The principle of operation of the Near Field Communication technology is essentially an extension of the ISO 14443 standard used for plastic cards. The NFC device forms a connection between the cards and the readers, which allows you to transmit information about operations. The connection between the card chip and the reader is maintained by induction of an electromagnetic field, and the card must be brought to the reader at a distance of no more than 20 cm. The standard is available in a wide frequency range with a bandwidth of about 2 MHz.

Conclusion. In this way, you can combine the advantages of the attributive and biometric methods. Updating the existing ACS at any facility will not require high costs, since you can use personal devices of employees (but if you want, you can provide everyone with the same smartphones).

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Аннотация. В статье предложен новый метод организации комбинированной СКУДна базе атрибутивного и биометрического методов. Используются технологии распознавания лица смартфонами, сканирования отпечатков пальцев, а также технология NFC. Подробно рассмотрены принципы работы считывания отпечатков пальцев и распознавания лица.

Ключевые слова: сканирование отпечатков пальцев, распознавание лица, технология ZWIPE, технология NFC, карты доступа, биометрия.

Annotation. The article proposes a new method for organizing a combined access control and management system based on the attributive and biometric methods. The technologies used are smartphone face recognition, fingerprint scanning, and NFC technology. The principles of fingerprint reading and face recognition are discussed in detail.

Keywords: fingerprint scanning, face recognition, ZWIPE technology, NFC technology, access cards, biometrics.

METHOD FOR INCREASING THE ACCURACY
OF THE POSITIONING DEVICE

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1. Introduction

In reality, satellite navigation systems are common in many areas of human activity. Today, such systems are present in most handheld devices such as smartphones, watches, etc.

The intensive growth of astronautics to create satellite methods for determining coordinates, which are used instead of fixed geodetic points, use artificial earth satellites moving in orbit. The first such system, working on this principle, was the system called "Cyclone" [1].

Satellite positioning can be applied in a variety of situations – from monitoring livestock in pastures to monitoring complex logistics systems.

In essence, any task of determining an object using satellite positioning systems is reduced to obtaining a set of coordinates.

However, many inexpensive positioning devices have relatively poor output accuracy. And in some cases, precise positioning is extremely important.

Such cases include tracking small-sized objects over a large area, planning the movement of objects in a confined space, etc.

The purpose of this work is to create methods for increasing the accuracy of the output data of the positioning device, based on making adjustments to the device software and post-processing of the received data.

2. Main part

Output variances can be caused by two types of factors. The first group includes factors that cannot be influenced, namely: various conditions associated with the transmission of data from a satellite to a device (interference caused by the position of satellites, weather conditions that interfere with signal propagation, etc.). The second group includes the factors associated with the lack of the receiving part of the positioning system: imperfection of the hardware; flaws that come from the software of the device.It is the inaccuracies associated with the receiver that we will minimize.

To carry out activities related to increasing the performance of the output data, one should consider the block diagram of the receiver (Fig. 1).
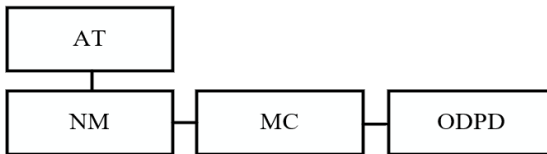
Figure 1 – The block diagram of the receiver

One should analyze the process of obtaining one packet of information. The signal from the satellite goes to the antenna (AT). Then it goes to the navigation module (NM), where it is converted to the NMEA 0183 protocol [2]. It is necessary to consider a snippet of an example protocol (Fig. 2).

`$GNGLL,5546.95900,N,03740.69200,E,102030.000,A,A*`

Figure 2 – A snippet of an example protocol

As one can see from Figure 2, the content of the package allows to determine the coordinates with a fairly good accuracy, however, most devices accept the final coordinate values as unreliable due to the lack of post-processing. By zeroing the last coordinate values, the output loses much of its accuracy.

To improve the positioning accuracy of the device under development, we will use the full package of coordinate values. And to filter the obtained

values, we will use an output data processing device (ODPD) using the Kalman algorithm [3].

We conducted an experimental study of the system described above. To conduct the experiment, we set the model to a point which coordinates are known, and we took data every ten seconds for twenty-four hours.

We constructed graphs based on the received data (Fig. 3).
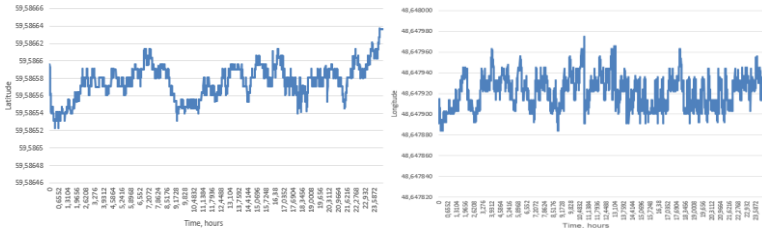
Figure 3 – Outliers caused by external factors

As one can see from Figure 3, the graphs contain outliers caused by external factors, but as a result of averaging the obtained data, the positioning accuracy is high. For greater clarity, we constructed the average value and the actual location on the map (Figure 4).

Figure 4 – The actual location on the map

Conclusion

Based on the results shown in Figure 4, it can be concluded that the measurement error was about one meter.

The developed positioning methods made it possible to determine the accuracy indicator of the output data without introducing structural changes into the parameters of the system.

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Аннотация. В статье рассмотрена разработка метода повышения точности позиционирования устройства навигационной системы (GPS). Навигационная система состоит из приемника, навигационного модуля, микроконтроллера и устройства обработки выходных данных. Принципы методов повышения точности основаны на расширенном чтении пакета позиционирования *NMEA*-0183 и постобработки полученных данных. Под постобработкой понимается использование алгоритма фильтрации Калмана и усреднение полученных результатов. В результате применения методов погрешность позиционирования снижается приблизительно до одного метра.

Ключевые слова: устройство позиционирования, повышение точности, фильтрация методом Калмана, обработка результатов позиционирования.

Annotation. The article development of method for increasing the positioning accuracy of the navigation system deviceis considered. The navigation system consists of a receiver, a navigation module, a microcontroller and an output data processing unit. The principles of methods for improving accuracy are based on extended reading of the NMEA-0183 positioning package and subsequent post-processing of the received data. Post-processing refers to the use of the Kalman filtering algorithm and the averaging of the results obtained. As a result of the application of the methods, the positioning error is reduced to approximately one meter.

Keywords: positioning device, improving accuracy, filtering by the Kalman method, processing positioning results.

ENVIRONMENT CLASSIFICATION FOR UNMANNED AERIAL VEHICLE USING CONVOLUTIONAL NEURAL NETWORKS

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Introduction.

In recent decades, unmanned aerial vehicles (UAVs) gained its popularity by being able to move in three-dimensional space. They are now used in many areas, such as surveillance, research, monitoring and search and rescue in situations that are too dangerous for humans.

The main problem of UAVs when the remote pilot is disconnected. The vehicle must have a certain level of autonomy to maintain the flight and it must be able to change its path and adapt to any situation to avoid the problem in accordance with weather conditions and position on the ground. For example, when flying through a dense cloud it is impossible to hold the aircraft and therefore the UAV has weather indicators that allow you to detect clouds. However, the intelligent system like a convolutional neural networks (CNN) can avoid them in a much more practical [1].

Definition of Convolutional Neural Networks.

The CNN is special architecture of artificial neural networks, proposed by Yann LeCun (French computer scientist) in 1988 and aimed at efficient pattern recognition, class of deep learning model. "Its need is undeniable, it is a tedious task for a person to generate a large data set and since very rarely requires access to this data" [2, p. 50].

Recently, deep learning methods have begun to be used to solve many problems in computer vision. In particular, CNNs are good image classifiers. Data generated by human expert and SVM (Support Vector Machine) is used to pre-train the network, it is worth noting that SVM classifies an image that is segmented using superpixels, that is, sub-regions represented only by a descriptor, instead of having multiple values for each pixel per sub-area.

Descriptors.

Basically descriptors are designed to classify only two classes and cannot be trivially scaled to M different classes. But we will consider descriptors with linear complexity and capable of increasing the number of classes to three (sky, earth and clouds).

Descriptors Based on Superpixel Segmentation and Histogram.

Here we will look at three descriptors that use their histograms as functions. Three images are needed to construct the required descriptors. Let (R,G,B) be the channels red, green, and blue, respectively and hence the descriptors will be obtained from $R-B$, R/B, and RGB images. Cloud detection algorithms use color to determine if a given area of the image is a cloud, this is done in a simple way, since cloud particles have the same intensity dispersion B and R when, in a clear sky, intensity B is greater than R, hence distinguishing a clear sky from the clouds will not be difficult.

"For N pixels, M superpixels will be generated based on color similarity and proximity using Simple Linear Iterative Clustering (SLIC)" [2, p. 2274-2282] in CIELAB color space. SLIC initializes M clusters centers $C_m = [l_m, a_m, b_m, x_m, y_m]^T$ on a regular grid space, where (l,a,b) is the color vector in CIELAB space and (x,y) are the pixel coordinates. Each superpixel has an approximate size of N / M and the center will be located every $S = \sqrt{N/M}$.

SLIC computes a distance D between pixel i and its nearest cluster center Cm:

$$D = \sqrt{d_c^2 + \left(\frac{d_s}{s}\right) r^2}$$

where $r \in [1,40]$ is a constant that allows pondering between color similarity and spatial proximity, dc and ds are defined by

$$d_c = \sqrt{(l_j - l_i)^2 + (a_j - a_i)^2 + (b_j - b_i)^2}, \quad d_s = \sqrt{(x_j - x_i)^2 + (y_j - y_i)^2}$$

The clusters are adjusted so as to take the value of the main pixel vector in Cm, the residualerror E between the centers of the clusters (new and previous) is calculated using the $L2$ norm, and the algorithm stops as soon as E reaches a certain threshold.

Convolutional Neural Networks.

CNN are used to process data located in a matrix or grid, for example, images that are represented by a 2D matrix, their name is a consequence of a mathematical operation called *convolution*, which in turn is an operation on two functions, creating a third function, which shows how one of them changes by the other. In computer vision and image processing, convolution is used to improve image performance and reduce noise.

Let $s(t)$ be the result of the convolution, then:

$$s(t) = \int l(a) * h(t - a) da,$$

where function l is the output of a sensor(input in CNN terminology), function h is weighting(or Kernel) and a is age of measurement. If time t can only take integers, then convolution can be characterized as a discrete operation, and then:

$$s(t) = \sum_{a=-\infty}^{+\infty} l(a) * h(t - a).$$

Input and output are multidimensional arrays, each element must be stored explicitly and separately. Infinite summation is implemented using a finite number of array elements and can be used not only on one axis at one time unit. Taking these facts into account, we assume that K is a two-dimensional kernel, I is a two-dimensional image, then the convolution for images is given as follows:

$$S(i,j) = (I * K)(i,j) = \sum_m \sum_n I(m,n) K(i - m, j - n)$$

The work of this formula is shown in the *Figure 1:*

where *I* and *K* (in the formula) are the Input and Kernel in the figure, respectively.
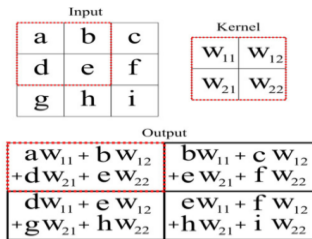
Figure 1 – Graphical description of convolution operation

Environment Classification with CNN

The convolutional neural network shows high efficiency in segmentation, recognition, and even in image detection. Let's consider its architecture *Figure 2*. the picture shows that each level uses the function of rectified linear units (ReLU) to activate them, but the last level is an exception, its activation function is sigmoidal, and therefore, is set $f(x) = 1/(1 + e^{-x})$.
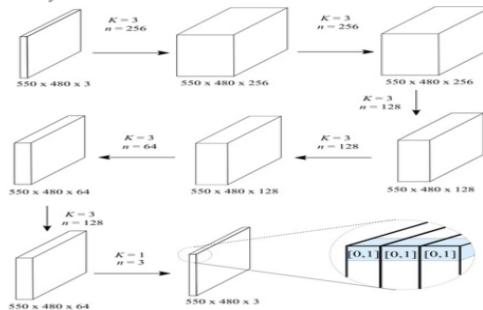
Figure 2 – Convolutional Neural Networks architecture.

The output image has three channels(for sky, cloud and ground) and each pixel is labeled based on the values of the three channels (with step = 1 and padding with zeros = 1).

Experimental Results.

Picture 3 presents ten test images in order to show how effective the proposed algorithm is. The photographs were taken on three different flights, but all flights were kept at the same altitude and had different weather conditions. The images from lines 5-7 were taken in direct and level flight, however they have a slight difference, but SPS – SVM (Super Pixel Segmentation – Support Vector Machine) clearly shows a different classification between them.
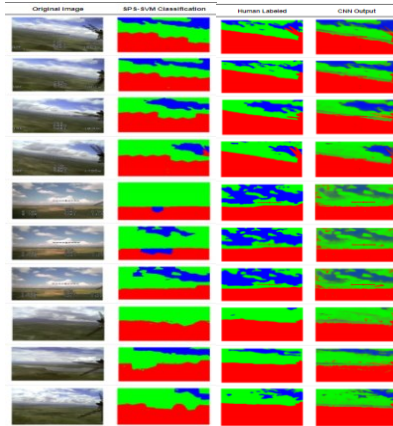
Figure 3 – Test images showing how effective
the proposed algorithm

The first column is the original image. The second column is the super pixel segmentation classification with vector machine support. The third column is the truth that the person sees. Fourth column classification made by CNN.

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Аннотация. Автор рассматривает дескрипторы с линейной сложностью и способностью увеличить количество классов до трех (небо, земля и облака). Проанализирована эффективность предложенного алгоритма.

Ключевые слова: свёрточная, нейронная сеть, суперпиксельная сегментация, дескриптор, гистограмма, кластер.

Annotation. The author considers the descriptors with linear complexity and capable of increasing the number of classes to three (sky, earth and clouds). The effectiveness of the proposed algorithm is analyzed.

Keywords: convolutional neural networks, super pixel segmentation, descriptor, histogram, cluster.

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INTELLIGENT GREENHOUSE LIGHTING

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Introduction

When growing plants in a greenhouse, one of the main tasks is to ensure optimal light conditions for each plant. A decrease in natural insolation caused, for example, by a short light day in the autumn-winter period or by a specific design and location of the greenhouse, leads to light starvation of the plant. To maintain optimal conditions for plant growth, it is necessary to use artificial light sources.

The organization of high-efficiency artificial lighting involves an individual selection of the spectrum, emission intensity and duration of illumination during the day for each plant. Consider the main parameters of the lighting plants.

The light spectrum is formed based on the energy absorption spectra of the basic plant pigments. Fig. 1 shows the absorption spectrum of photosynthesis.

Also, in addition to chlorophyll pigments with absorption peaks in the range of 400-500 nm and 650-700 nm, the growth processes are influenced by auxiliary pigments from the family of light-collecting phycobiliproteins (phycocyanin, phycoerythrin, allophycocyanin), which "absorb photons in the wavelength band of 480-650nm" [4, p. 260]. Thus, to ensure effective illumination, it is necessary to form a spectrum in the entire wavelength band perceived by plants from 400 to 700 nm with emission peaks according to the absorption of pigments.
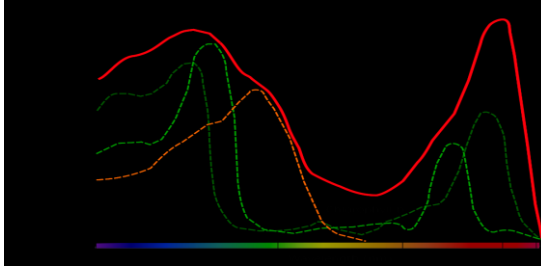
Fig. 1 — Photosynthesis absorption spectrum

To quantify the light effect on plants, a parameter such as the photosynthetic photon flux density (PPFD) is used. Photosynthetic photon flux is the quantity of photons in the wavelength band from 400 to 700 nm that hit the surface in one second. PPFD is measured in micromoles per square meter per second $\mu mol/(m^2 s)$.

Also, when lighting plants, it is necessary to take into account the photoperiod for different types of plants (light-loving, shade-loving, shade-tolerant). "For correct growth and flowering, plants require an average of 6 hours of darkness during the vegetative phase and 12 hours of darkness during the flowering cycle" [4, p. 340]. Changing the day-night ratio can negatively affect plant growth.

Artificial light sources

Currently, many sources of artificial lighting for growing plants are known. However, existing light sources such as incandescent lamps, sodium and fluorescent lamps have a number of disadvantages that do not allow to organize high-efficiency artificial lighting of plants.

Using an incandescent lamp as a source of artificial lighting in a greenhouse is an inexpensive, but ineffective solution. "The luminous efficiency of such a source is only 10-15 lm/W with an average service life of 1000 hours" [1, p. 69]. Moreover, the emission spectrum of an incandescent lamp is unfavorable for plant growth, since the emission is maximum in the red region of the spectrum (≥630 nm) and minimum in the blue region (450-480 nm).

Fig. 2 shows the emission spectra of various artificial light sources.

In contrast to incandescent lamps, fluorescent lamps have a greater luminous efficiency of about 60-80 lm/W and "an average service life of 10,000 to 20,000 hours" [2, p. 173]. However, the emission spectrum of fluorescent lamps is mainly in the green and orange regions (550-630 nm), which does not correspond to the absorption peaks of chlorophyll pigments in the blue region of the spectrum. Also, as a source of artificial lighting in greenhouses, High-pressure sodium arc lamp (HPS) are used, which have a

high luminous efficiency of about 85 lm/W (lamp with a power of 250 W) and a service life of up to 30,000 hours [3, p. 29]. The disadvantages of the lamp are the complexity of installation, long ignition and the almost complete absence of green and blue components in the emission spectrum of the lamp.
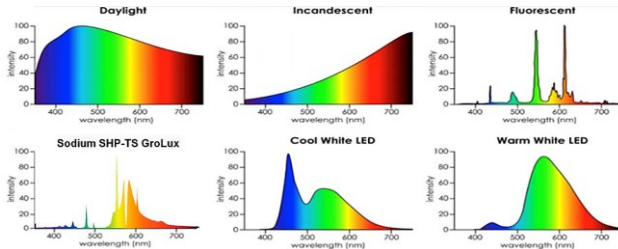
Fig. 2 — Emission spectra of various artificial light sources

Different from the mentioned light sources, LED (light emitting diode) lamps are devoid of the listed disadvantages. At the same time, "the luminous efficiency of the LED lamp is up to 100 lm/W and a service life of up to 100,000 hours" [5, p. 112]. Existing phytolamps on LEDs have a emission spectrum mainly in the blue and red regions, corresponding to the maximum absorption of the chlorophyll pigment. However, at different stages of plant growth, it is also necessary to illuminate in the spectral region corresponding to the auxiliary pigments.

Led programmable lamp

Based on the analysis, it can be argued that the light emitting diode is the most energy-efficient source of artificial light for greenhouses. To create an effective and universal LED lamp, it is necessary to provide the possibility of individual lighting settings for any type of plant.

The block diagram of the developed programmable LED lamp is shown in Fig. 3.
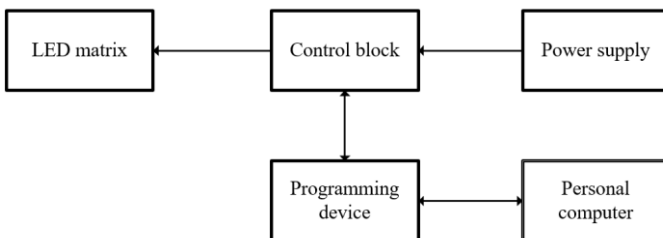
Fig. 3 — The block diagram of the developed programmable LED lamp

Using the software and the programming device, you can control the lamp and adjust the spectrum, emission intensity and photoperiod individually for each plant.

The LED matrix of the luminaire consists of several controlled groups of phyto-light diodes, namely, 4 groups of "Sunlike" LEDs of different color temperatures (6500K, 5000K, 4000K, 3000K) and 2 groups of LEDs corresponding to the peak absorption of the chlorophyll pigment (445 nm and 660 nm).

This construction of the LED matrix will allow you to adjust the emission spectrum in the range from 400 to 800 nm. The minimum PPFD parameter of such a matrix is 350 µmol/(m²s) at the height of the lamp suspension of 30 cm. The matrix is controlled via the CAN interface from the control block.

The DLI (day light integral) or daily PPFD parameter of the lamp is calculated according to the following expression:

$$DLI = \frac{PPFD \times 3600 \times T_p}{1000000}, \tag{1}$$

where PPFD in µmol/(m²s); T_p — photoperiod (hours per day); 1 hour = 3600 seconds; 1 mol = 1000000 micromol.

In this case, the decrease in light intensity (PPFD) with increasing distance is described by the inverse square law. The results of the calculations are shown in Table 1.

Table 1 — Results of the lamp DLI calculations

Lamp suspension height, m	PPFD µmol/(m²s) instantaneous	T_p (photoperiod), hours per day					
		18	16	14	12	10	8
0.7	64	4	4	3	3	2	2
0.6	87	6	5	4	4	3	2
0.5	126	8	7	6	5	4	4
0.4	197	13	11	10	8	7	6
0.3	350	22	20	17	15	12	10
		DLI (daily PPFD), mol/(m²d)					

Conclusion

The article considers the main parameters for the organization of artificial greenhouse lighting and provides a comparative analysis of existing lighting sources.

The analysis of the characteristics showed that LEDs are the most energy-efficient sources of artificial light, and the advantage of LEDs is the ability to create the necessary emission spectrum for different plant species at each stage of growth.

The developed LED lamp with the possibility of individual lighting settings for each plant is proposed for consideration. The block diagram of the developed lamp is given and calculated parameter of the daylight integral (DLI) depending on the height of the suspension and the duration of the photoperiod.

Based on the developed lamp, it is possible to organize an intelligent lighting system consisting of several lamps and a single control and configuration center.

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Аннотация. В статье рассмотрены основные параметры для организации искусственного освещения теплицы и проведен сравнительный анализ световой отдачи и спектра излучения существующих источников освещения. Также в рамках статьи описан разработанный программируемый светодиодный светильник, приведена его структурная схема и светотехнические характеристики.

Ключевые слова: искусственное освещение, теплица, светодиод, световая отдача, фотосинтез.

Annotation. The article considers the main parameters for the organization of artificial greenhouse lighting and provides a comparative analysis of the luminous efficiency and the emission spectrum of existing

lighting sources. The article also describes the developed programmable LED lamp, provides its block diagram and lighting characteristics.

Keywords: artificial lighting, greenhouse, light emitting diode, luminous efficiency, photosynthesis.

EXPERIMENTAL EQUIPMENT FOR RESEARCH THE ATTENUATION OF LOW-FREQUENCY ELECTROMAGNETIC WAVES IN ROCKS

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1. Introduction

The mining industry is one of the most actively developing sectors in the Russian Federation. This is due to the fact that the share of the mining industry in Russia's GDP is about 10%. According to the State Program for the development of the industry for the period up to 2030 it is planned to increase the production of all minerals by at least 1.7 times [4].

There are two ways of mining — open and closed. At the moment, the most common open method of mining, that is, in quarries. However, mining in mines, that isclosed method is more dangerous [1]. Thus, according to Rostekhnadzor data, only in the Siberian Federal District in 2020 there were 22 accidents and incidents in mines. A total of 23 people died [2].

Therefore, the problem of quickly finding victims under the rubble is acute.

To search for victims, special search devices are used, which should provide the maximum search range and the minimum error in determining the location of victims in conditions of strong attenuation of electromagnetic waves [3].

The objective of this work is to develop an experimental setup for studying the attenuation of electromagnetic waves in a wide frequency range in various rocks.

2. Main part

A generalized block diagram of the developed installation is shown in Figure 1. The installation is a transmitting-receiving system consisting of a transmitter (T) with a magnetic antenna (MA1) and a receiver (R) with a magnetic antenna (MA2). The medium between the receiver and the transmitter, which contributes attenuation to the radiated electromagnetic field, can be metal structures, rocks, concrete and reinforced concrete structures.
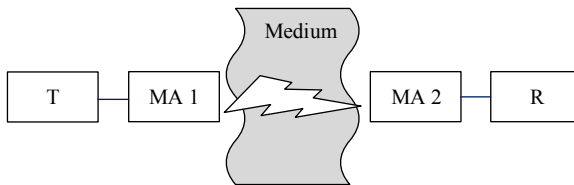
Figure 1 – A block diagram of the developed installation

This device should provide the maximum search range and the minimum error in locating victims in conditions of strong attenuation of electromagnetic waves. Therefore, it is most appropriate to use devices operating at frequencies ranging between 3 to 300 kHz. This statement was based on preliminary experimental research [3].

The structural diagram of the transmitter is shown in Figure 2, *a*. The transmitter consists of an external master generator (EG) and a power amplifier (PA). The power amplifier must be included in the transmitter to solve the problem of obtaining a significant output signal power in a wide frequency band. Using just one generator (for example, a low-frequency frequency synthesizer (G3-110) is not able to solve the above problem, because this generator can only generate low-power signals, the maximum signal level is 2 V with a load of 600 Ohms. The problem of obtaining a significant output signal power in a wide frequency band is still relevant. Therefore, in order to build a measuring system, a power amplifier must be included in the transmitter.

Since the low-frequency power amplifier will work at a fixed active load in a wide frequency range, the output stage of the amplifier must be realized by transformer scheme with a large number of taps. At the same time, it is reasonable to make the transformer taps both on the input side, optimizing its work at the selected operating frequency, and from the output side, optimizing its work on the selected load.
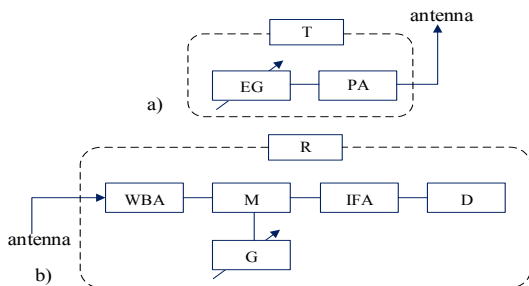
Figure 2 – The structural diagram of the transmitter

Also another important fact is the use of this amplifier in the field. In this case, considerable attention is paid to the issues of high efficiency and size and weight. Therefore, for the operation of the power amplifier, it is necessary to choose the pulse mode of the amplifier, which ensures minimal power loss on the active elements of the amplifier.

Using the pulse mode of operation of the amplifier implies the presence of an input signal from an external master generator of constant amplitude. The output power of the transmitter in this case can be changed in a wide range by changing the duty cycle of the output pulses. Thus, the amplifier must be with pulse-width control of the output power. The power amplifier must operate in a wide frequency range, and the value of the duty cycle of the output pulses must not change when the changing the frequency of the input triggering pulses coming from an external master oscillator with quartz frequency stabilization changes.

The structural diagram of the receiver is shown in Figure 2, *b*. The receiver is built according to the classical superheterodyne scheme and consists of a wideband amplifier (WBA), a mixer (M), a tunable generator (G), an intermediate frequency amplifier (IFA) and a detector (D). Due to such realization of the receiver, it is possible to receive and amplify signals in a narrow frequency band at any operating one of the measuring system.

Conclusion

Developed structural schemes of transmitting and receiving devices allow to create a facility for experimental studies of the attenuation of electromagnetic oscillations in different environments to select the optimal frequency of oscillations in terms of maximum penetration of the radio signal.

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Аннотация. В статье рассмотрена разработка блок-схемыэкспериментальной установки для исследования затухания электромагнитных волн низкочастотного диапазона в горных породах. Данная установка работает по принципу приемо-передающей системы. Система состоит из передатчика с магнитной антенной и приемника с магнитной антенной. Передающая часть системы способна формировать и излучать низкочастотные радиосигналы в диапазоне от 3 до 300 кГц с одинаковой мощностью, а принимающая часть определять их уровень с учетом затухания в среде распространения. Это позволит определить зависимость проникающей способности радиосигналов с различными частотами от проводимости среды и определить оптимальные частоты для конкретных горных пород. Использование данной зависимости позволит повысить дальность работы системы и улучшить точность позиционирования в задачах поиска людей под завалами.

Ключевые слова: распространение электромагнитных волн, магнитная антенна, горнодобывающая промышленность, проникающая способность.

Annotation. The article considers the development of a block diagram of an experimental equipment for research the attenuation of low-frequency electromagnetic waves in rocksis. This unit operates on the principle of a receiving and transmitting system. The system consists of a transmitter with a magnetic antenna and a receiver with a magnetic antenna. The transmitting part of the system generates and emits low-frequency radio signals in the range from 3 to 300 kHz with the same power, and the

receiving part measures their level with considering the attenuation in the propagation environment. This will make it possible to determine the dependence of the penetrating ability of radio signals with different frequencies on the conductivity of the environment and to determine the optimal frequencies for specific rocks. The use of this dependence will increase the range of the system and improve the positioning accuracy in the tasks of search people under the rubble.

Keywords: electromagnetic wave propagation, magnetic antenna, mining industry, penetrating power.

WIRELESS TRANSMISSION OF ELECTRICITY

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Wireless electricity has been around since 1831, when Michael Faraday discovered the phenomenon of electromagnetic induction. He experimentally established that a changing magnetic field generated by an electric current can induce an electric current in a different conductor. Numerous experiments were carried out, thanks to which the first electrical transformer appeared. However, only "Nikola Tesla managed to fully embody the idea of transmitting electricity at a distance in practical application" [3, p. 32].

Wireless power transmission may be a key technology for renewable energy, which typically generates energy far from where it is needed. And the capacity of existing power grids does not allow transferring large amounts of such energy far enough from the place of generation.

Induction power transmission

Induction power transmission Induction power transmission refers to the wireless transmission of power over a distance. This method is based on the phenomenon of mutual induction of two inductors. If an alternating current is applied to one coil, then an EMF of mutual induction will be induced in the other coil, which is in the magnetic field of the first coil [1].

In addition to transformers, the transmission of energy by induction has been used to transfer energy to electric vehicles from the road, as well as in magnetic levitation trains and other devices. The range and efficiency

of the induction method of energy transfer depends on the design of the coils, the current in them, on the distance between the coils and the magnetic properties of the medium between them.

Recently, it has been more often suggested to use induction power transmission for use in a vehicle. This idea is over a hundred years old. HF transport systems are a transformer, the primary winding of which is laid along the route, and the secondary winding is in the car. Energy is transmitted using an electromagnetic field [4]. One of the coils is supplied with high power from a high-frequency generator. This coil is usually located in the ground under the road surface. The second coil, with the help of a capacitor, is tuned to the frequency of the generator, is a receiver of electrical energy and is located on the vehicle. When the coils are located close, the EMF induced in the receiving circuit is rectified, and a direct current is supplied to the vehicle's electric motors.

Electrodynamic induction works like this. When an alternating electric current passes through the primary winding, an alternating magnetic field exists around it, which simultaneously acts on the secondary winding, inducing an alternating EMF and, accordingly, an alternating current in it.

To obtain a higher efficiency, the relative position of the primary and secondary windings must be close enough. If, under the conditions of the experiment, we begin to move the secondary winding away from the primary, then the part of the magnetic field reaching the secondary winding and crossing its turns will become less and less [1].

As the secondary winding moves away, even at a small distance, the inductive coupling between the windings will eventually become so small that most of the energy transmitted by the magnetic field will be wasted extremely inefficiently and generally wasted.

A similar system in its simplest form is presented in a classic electrical transformer. After all, a transformer is the simplest device for wireless transmission of electricity, since its primary and secondary windings are not galvanically connected to each other. The transfer of energy from the primary to the secondary is realized in it through a process called mutual induction [2]. The main function of the transformer is to increase or decrease the voltage supplied to the primary winding.

Electrodynamic induction methods are implemented in contactless chargers for mobile technology. The disadvantage of transferring energy in this way is the very short effective distance. To achieve proper efficiency, the transmitter and receiver must be placed very, very close to each other, practically close to each other, so that in principle they can effectively interact with each other.

In order to improve the efficiency of the induction method, it is useful to introduce into such a system the phenomenon of electrical resonance, which will increase the effective transmission distance. With the addition of an oscillatory circuit to the resonant circuit, by its action, to some extent, it increases the effective transmission distance. For resonance to occur, the transmitting and receiving circuits must be tuned to the same common frequency [1].

A technique of this kind has been adopted as part of the Qi wireless charging standard. This standard provides for two options for power transmission: low power - from 0 to 5 watts and medium power - up to 10 watts. The standard was developed after 2008 by the Wireless Power Consortium (WPC) to transmit energy over a distance of 4 cm.

Qi-enabled hardware includes a flat coil transmitter (located behind the plate) that connects to a stationary power source, and a compatible receiver that is installed inside the device to be charged (also in the form of a flat coil) [4]. When using the charger, the plug-in device is placed on the transmitter plate. In this case, the principle of electromagnetic induction operates between these two flat coils, as in a transformer.

Other methods of transmission of electrical energy:

Electrostatic induction

Electrostatic or capacitive coupling is the passage of electricity through a dielectric. In practice, this is an electric field gradient or differential capacitance between two or more insulated terminals, plates, electrodes, or nodes that rise above a conductive surface. The electric field is created by charging the plates with alternating current of high frequency and high potential. The capacitance between the two electrodes and the powered device forms a potential difference.

Microwave radiation

Radio wave energy transmission can be made more directional by significantly increasing the effective transmission distance by decreasing the wavelength of electromagnetic radiation, usually to the microwave range. To convert microwave energy back to electricity, rectenna can be used, the energy conversion efficiency of which exceeds 95%. This method was proposed for transferring energy from orbiting solar power plants to Earth and powering spacecraft leaving Earth's orbit.

Laser method

If the wavelength of electromagnetic radiation approaches the visible region of the spectrum, the energy can be transferred by converting it into a laser beam, which can then be directed to the photocell of the receiver.

Laser energy transmission has a number of advantages over other wireless transmission methods:

• transmission of energy over long distances (due to the small value of the angle of divergence between narrow beams of a monochromatic light wave);

• ease of use for small products (due to the small size of a solid-state laser - semiconductor diode);

• absence of radio frequency interference for existing communication devices such as Wi-Fi and cell phones (the laser does not create such interference);

• the ability to control access. This method also has a number of disadvantages:

• conversion of low-frequency electromagnetic radiation into high-frequency radiation, which is light, is ineffective. Converting light back to electricity is also inefficient, since the efficiency of photocells reaches 40-50%, although the conversion efficiency of monochromatic light is much higher than that of solar panels;

• losses in the atmosphere;

• the need for line of sight between transmitter and receiver (as with microwave transmission).

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Аннотация: В статье исследуются способы передачи электрической энергии на расстоянии, принципы работы устройств для передачи электроэнергии, достоинства и недостатки различных способов передачи электрической энергии, таких как электромагнитная индукция, электростатическая индукция, микроволновая радиация и лазерный способ передачи энергии.

Ключевые слова: беспроводная передача энергии, электромагнитная индукция, трансформатор, магнитное поле, энергосети, возобновляемые источники энергии.

Annotation. The article examines the methods of transmitting electrical energy at a distance, the principles of operation of devices for transmitting electricity, the advantages and disadvantages of various

methods of transmitting electrical energy, such as electromagnetic induction, electrostatic induction, microwave radiation and laser energy transmission.

Keywords: wireless power transmission, electromagnetic induction, transformer, magnetic field, power grids, renewable energy sources.

DEVELOPMENT OF A TESTING AREA FOR MEASURING PARAMETERS OF MOVEMENT OF SMALL-SIZED UAVS

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Introduction

In modern realities, time is becoming an increasingly valuable resource. Three-dimensional models of a space or object in space help to simulate various situations without conducting tests on the ground, thereby saving time. At the moment, humanity is faced with the task of automating the process of obtaining a three-dimensional model, preserving all its smallest details. The projection can be obtained in many ways, including the use of an unmanned object, and in the case of increasing the speed of scanning and creating a projection, we are talking about a swarm of such objects. However, there is a problem of creating a system that would control the swarm so as to avoid the possibility of objects colliding in the air, as well as to ensure a systematic recording of the projection.

The main part

At the beginning of the previous year, research group within the framework of the study of the discipline "Engineering Design" creating a financially affordable test site for tracking and capturing data on the movement of a swarm of small unmanned vehicles. This polygon is necessary to be able to adjust the motion parameters and debug in order to upgrade the motion algorithms.

At the stage of choosing a method for determining the position of devices in space, we considered several methods, including "acoustic, radio frequency, inertial, hybrid, and optical" [1, p. 229]. Most of the methods either fail to achieve the desired result, or are too expensive at the initial

stage of polygon development. Therefore, it was decided to use the optical method.

It was decided that in order to study the parameters of the movement of the swarm of UAVs, cameras and sensors should be placed in the room that will track the movement of the swarm of UAVs. The group proposed an algorithm for calculating the distance between the models and the cameras, as well as the mutual distance between the two models. The ball was chosen as the basis for the shape of the layout because of its shape, which is as close to ideal as possible. The purpose of the experiments was to determine the error in the calculation of the actual parameters (the distance between the two balls, the distance between the camera and the balls) and the values obtained as a result of the calculation from the photographs taken.

To do this, we conducted a series of experiments and obtained results that indicate that the method for determining the necessary data was chosen correctly.

In experiment №1, we suspended two tennis balls at a random distance from each other, which was then measured to be 160 cm. Also, the diameter of the balls was measured, and the camera parameters, such as the focal length of the lens and the resolution in pixels, were recorded in the source data. The rest of the required values were obtained from the experience photo using special programs. After that, using the derived formulas for finding the distance from the lens to the target object, we calculated the distance to the balls. With its help, the distance between the balls was calculated. The calculated value was 208 cm, which is 23% more than the real one. The location of the balls is shown in Figure 1.

The report we compiled on the experiment shows a complete list of the reasons for such a large error. One of the main reasons is that the shooting was done without a tripod, the camera was not calibrated, and there were not enough initial measurements.

After the relatively unsuccessful experiment №1, experiment №2 was performed, in which errors were taken into account, and the relative error was significantly reduced from 23% to 2,7%.
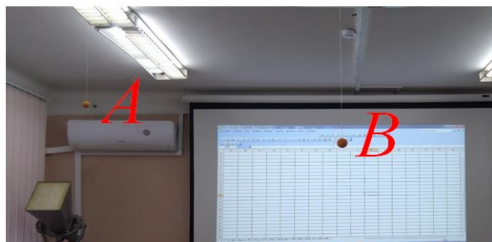
Figure 1 — The location of the balls

The group carried out 4 similar measurements and calculations of parameters to verify the results. In each of the dimensions, the balls were in different projections and at different distances from each other. And also, the balls were replaced with smaller ones, which can give a greater margin of error. A more detailed course of calculations and analysis was described in the report on experiment № 2.

Conclusion

After conducting two experiments, we came to the conclusion that the method chosen by us can actually be used to create a test site.

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Аннотация. БПЛА и роевые технологии становятся неотъемлемой частью развития технологической сферы, как в промышленном масштабе, так и на потребительском уровне. Каждый день, во всем мире, они уже выполняют самые сложные задачи, которые не под силу человеку. Однако, для более четкого выполнения задачи, все БПЛА должны быть откалиброваны, а алгоритмы движения выверены до мельчайших деталей. Для этого необходимо построить соответствующие полигоны, которые будут отвечать определенным требованиям, и выполнять поставленную задачу. Проведено экспериментальное исследование величины погрешности измерения параметров движения роя.

Ключевые слова: роевые технологии, метод, расстояние, макет, фотография, БПЛА, полигон, эксперимент.

Annotation. Drones and swarm technologies are becoming an integral part of the development of technologies, both on an industrial scale and on a consumer level. Every day, all over the world, they are already performing the most complex tasks that are beyond the power of man. However, for a clearer performance of the task, all drones must be calibrated, and the motion algorithms are verified to the smallest detail. To do this, it is necessary to build the appropriate polygons that will meet certain requirements and fulfill the task. We conducted an experimental study on the size of the error in measuring the parameters of the swarm movement.

Keywords: optical distance measurement method, swarm model of small-sized objects.

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BIODIESEL AS AN INNOVATION

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Recently, more and more attention is being paid to environmental problems, as well as the gradual depletion of oil reserves. One of the alternative sources of energy could be biodiesel. It is believed that biodiesel can help mankind with a number of environmental problems and increasing energy consumption.

The aims of our research are:

1. To tell about the main sources of raw materials.

2. To show the differences of different generations of biodiesel.

3. To describe the technology of biodiesel production.

The objectives are the following:

1. To highlight the advantages and disadvantages of some types of raw materials

2. To clarify which type of feedstock is the most effective for production

3. To describe the transesterification reaction and types of catalysts for its implementation.

Descriptive method, comparative method, analysis of lexical definitions were chosen as main methods of research.

The theoretical basis of the study was the works of the following researchers: Kuchkina A.Yu., Sushchi N.N. [2], Gafurov N.M., Khismatullin R.F. [1], Markov V.A. [3], Kaskov S.I., Loboda S.S., Erdiwansyah Mamat R., Sani M.S.M., Sudhakar K., Kadarohman A. [4].

Practical significance of the work consists in the possibility of applying the results obtained on the implementation of biodiesel in the industrial spheres of life of the state. With a fairly simple way of obtaining this type of fuel and great advantages compared to petroleum fuel, its implementation will bring a contribution to human health, as well as economic benefits.

So, why is biodiesel an innovation?

First of all, biodiesel is a relatively new type of environmentally friendly fuel, which is produced from renewable resources.

Secondly, it is used in motor vehicles in pure form and in the form of various blends with diesel fuel. In the U.S. a blend of diesel fuel with biodiesel is designated by the letter B; the number after the letter means the percentage of biodiesel content. B2 - 2 % biodiesel, 98 % diesel fuel. B100 - 100 % biodiesel. A similar fuel labeling system was introduced in the EU in 2018. Compared to petroleum diesel, biodiesel is characterized by better emissions, beneficial for agriculture, compatibility with existing engines and infrastructure, and ease of manufacture.

Furthermore, biodiesel is a mixture of monoalkyl esters of fatty acids obtained from triglycerides by transesterification reaction (esterification) with monatomic alcohols. Biodiesel is made from a range of vegetable oils. Since the carbon in oils or fats comes primarily from air carbon dioxide, biodiesel is believed to contribute less to global warming than fossil fuels.

At the same time, a significant disadvantage of Biodiesel is its poor low-temperature properties, which can be improved by mixing with depressant additives, or components that have good low-temperature properties (light fractions, kerosene, etc.).

Today, there are various types of biofuels, which differ in raw materials and approaches used for its processing.

A few points should be taken into account:
- The fuel is classified by generation that depends on the material.
- The first generation is biological fuel from agricultural crops.
- The second generation is biological fuel from fatty waste.
- The third generation is biological fuel from algae with a high oil content.

The first generation fuel

Different countries and regions use different crops as raw materials because of features of the territory. The most famous sources of raw materials are rapeseed, corn, castor and palm oils, jatropha, soy. The optimal raw material for the production of biodiesel is rapeseed. The percentage of diesel fuel output from 1 ton of rapeseed oil is 96%.The cultivation of crops requires quality arable land. Numbers of cultivated areas for crops intended for nutrition is decreasing. This leads to an increase of food prices. The raw material has a rather high price because it needs in fertilizers, pesticides, harvesting equipment.

The second generation fuel

This is the fuel from all kinds of waste, for example, utilities, food and woodworking industries, agriculture. The production of such biodiesel fuel will allow to avoid bioenergy competition with the food sector of the economy and to solve problems of recycling waste from various industries.

The third generation fuel

You can get the fuel from water plants and heterotrophic organisms. People use open and close ponds and bioreactors. On the one hand, seaweed has a high growth, able to grow on waste and clean water from an organic rubbish. But, on the other hand, fat productivity is not great in open ponds. Then, ponds have got a small temperature and light, there is a risk of infection with other strains. It is also obvious that effective cultivation of algae in open water bodies is possible only in regions with a warm climate and intense insolation. A significant disadvantage of microalgae as a raw material for biodiesel fuel is the high content of polyunsaturated fatty acids, which leads to decrease in oxidative stability and deterioration of some other fuel characteristics of biodiesel [3].

Biodiesel production technology

There are different ways to make biodiesel, but the most popular is a process that called transesterification. Firstly, the fat or oil is purified and then combined with an alcohol, usually methanol (CH_3OH) or ethanol (CH_3CH_2OH). The reaction between biolipid (fat or oil) and alcohol is reversible, so an excess of alcohol is required to ensure complete conversion.Connection is ensured by catalysts like a potassium hydroxide (KOH) or sodium hydroxide (NaOH). As a result, triacylglycerol is converted to esters and glycerin. The remaining esters are what we call biodiesel.During the transesterification process, the total fatty acid composition of the fat mixture does not change [4].

Kinds of catalysts

1) homogeneous catalysts (alkaline: KOH, NaOH, alkoxides; acidic: H_2SO_4, H_2SO_3, H_3PO_4).

Transesterification of triglycerides is possible in the presence of acid catalysts (H_2SO_4, H_3PO_4). The advantage of using acid catalysts is the ability to carry out the transesterification process in the presence of significant amounts of fatty acids and water. but a speed of the reaction is lower than the presence of alkaline catalysts. Proved that using sodium alkoxide accelerates in 4000 times the transesterification than the equivalent of the amount of HCl [1].

To date, transesterification using basic homogeneous catalysts is the most common process for the production of biodiesel. In this process, it is necessary to use raw materials (vegetable oils or animal fats) with a low content of free fatty acids. In the case where the feedstock has a high content of free fatty acids or water, the alkaline catalyst reacts with the free fatty acids to form soaps, and the water can hydrolyze the triglycerides to diglycerides, increasing the content of free fatty acids.

In particular, the total concentration of free fatty acids should not exceed 0.5 wt.%. The total water content should not exceed 0.1 – 0.3 wt.%.

The presence of water in the raw material contributes to the hydrolysis of esters, the formation of free fatty acids and, as a result, soap.

2) heterogeneous catalysts (various metal oxides, metal complexes, alkaline and alkaline-earth metals deposited on the carrier, as well as zeolites). They are less sensitive to the quality of raw materials, do not form soaps, are less corrosive and environmentally less dangerous, and the use of heterogeneous catalysts avoids the time-consuming stage of separation of the catalyst and products.

The existing heterogeneous transesterification catalysts can be divided into three types: acidic, basic, and a separate class are enzymes that act as electron donors (or proton acceptors). The activity of heterogeneous catalysts is explained by the presence on their surface of a large number of strong basic, acidic or both types of centers.

One of the main disadvantages of homogeneous catalysts is the difficulty associated with the separation and regeneration of catalysts.

In order to test and evaluate the properties and characteristics of biofuels ourselves, we decided to conduct an experiment. The practical process for producing biodiesel fuel based on unrefined rapeseed oil can be described as follows: oil weighing 475.3 g was poured into a glass and stirred evenly to a temperature of 45 degrees Celsius. The increase in temperature was due to the catalyst, the mass of which is 1.75% of the oil mass. Alkali was used as a catalyst. After that, an alcohol weighing 138.21 g was added. The mixing time of the mixture is approximately 1 hour. After that, you need to pour the fuel into a funnel for settling and separation into phases.

The lightest lower phase is glycerin, which we need to drain into a separate container. The glycerin mass was 119 g. Biodiesel is an ester that is formed as a result of transesterification. The fuel mass was 318.8 g. The next point of our experiment was vacuum distillation with a still. As a result, we have separated alcohol from biofuel. Next, we weigh again to determine the mass after distillation. It was 307.5 g. In the next part of the experiment, we checked the properties of the resulting biodiesel. Add a small amount of fuel to the test tube and lower it into a cryostat, into which alcohol is poured. The temperature in the cryostat is -34 degrees. Using this equipment, it was found that the turbidity of biodiesel occurs at a temperature of -7.5°C, and the freezing point is 19 degrees. In this case, the fuel temperature before installation in the cryostat was 21°C.

Thus, we got a fairly low freezing point. Because of this, this type of fuel is used as an additive to diesel fuel or in countries with warm climates. The Stabinger Viscometer can be used to obtain viscosity index and density. Approximately 5 ml of the fuel sample was introduced into the measuring

cell. So that no fuel drops remain on the capillaries, we clean them with petroleum ether and blow with air. Set on the viscometer temperatures 15, 20, 40 degrees Celsius. In this case, we obtain the exact values of the characteristics. Measurements were carried out 3 times for each temperature. In the course of the experiment, the following dependence was established: with increasing temperature, the viscosity coefficient decreases compared with the characteristics of diesel fuel. As a result, biodiesel was more stable in the cold. When comparing the characteristics of a mixture of diesel fuel and biodiesel in the ratio of 80 %: 20%, biodiesel has improved cold resistance, which proves the profitability of biodiesel. The yield of biodiesel during the experiment is 62 %.

Heterogeneous catalysts can potentially be regenerated and reused. Therefore, in addition to the activity, it is also of interest to establish the reasons for the deactivation of heterogeneous catalysts and the methods of their regeneration [2].

After studying the theoretical material, we made the following conclusions:

1) Biodiesel is less harmful to the environment, because it is a renewable resource.

2) There are 3 generations of biodiesel, the most promising of them for Russia, we consider the biodiesel of the 1st generation.

3) Biodiesel can be used on both water and land vehicles with diesel engines.

4) A number of oils can be used as raw materials, but we consider rapeseed oil to be a more profitable raw material for biodiesel.

5) Despite the disadvantages of biodiesel, we believe that the rational use of this type of fuel will allow vehicles to operate with the same efficiency as if diesel fuel were used.

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Аннотация. Статья посвящена выявлению и исследованию альтернативных источников промышленных топлив, в частности биодизельного топлива, для снижения использования нефтяных углеводородов в качестве различных видов топлива.

Описан выбор наиболее подходящего сырья для производства, а также проведена оценка качества топлив 1-го, 2-го и 3-го поколений, описаны их характеристики. Проведен анализ наиболее эффективного катализатора для повышения выхода продукта. Приведено описание его плюсов и минусов, а также сравнение свойств биодизеля с обычным маслом.

Ключевые слова: биодизельное топливо, топливо 1-го, 2-го и 3-го поколений, катализаторы, переэтерификация, эксперимент, криостат, визкозиметр,перегонка в вакууме.

Annotation. The article is devoted to the identification and research of alternative sources of industrial fuels, in particular biodiesel, to reduce the use of petroleum hydrocarbons as various types of fuels. The selection of the most suitable raw material for production is described, and the quality of fuels of the 1st, 2nd and 3rd generations is assessed, and their characteristics are described.

The analysis of the most efficient catalyst to increase the product yield has been carried out. A description of its pros and cons, as well as a comparison of the properties of biodiesel with conventional oil was made.

Key words: biodiesel, 1st, 2nd and 3rd generation fuels, transesterification, catalysts, experiment,cryostat, viscometer, glycerin, vacuum distillation.

NEW CLASSES OF HILBERT SPACES WITH A REPRODUCTIVE CORE

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Introduction

In communication theory and antenna theory, integral transformation widely used of the form:

$$f(t) = \int\limits_{-\infty}^{\infty} g(\tau)\frac{\sin\pi(t-\tau)}{\pi(t-\tau)}\,d\tau\,,$$

which is a Hilbert transform with a reproducing kernel $T(t,\tau) = \dfrac{\sin\pi(t-\tau)}{\pi(t-\tau)}$.

For such transformations, it is true:

$$\varphi_n(t) = \lambda_n \int\limits_{-\infty}^{\infty} \varphi_n(t)T(t,\tau)\,d\tau\,,$$

where $\varphi_n(t)$ — native function, λ_n — eigenvalues of integral transformation.

In the theory of integral transformations, it is proved that eigenfunctions corresponding to one eigennumber are orthogonal. The degenerate nucleus of such a transformation is represented as

$$T(t,\tau) = \sum_{n=1}^{\infty}\lambda_n\varphi_n(t)\varphi_n(\tau)\,. \tag{1}$$

In work [1] systems of orthogonal functions of the form are considered

$$\varphi_n(t) = \frac{\sin^k\pi(t-n)}{[\pi(t-n)]^k}\,,\ k = 1,\,2,\,3,\dots, \tag{2}$$

weight of orthogonality of which is an even polynomial of the function $\sin\pi t$.

It is advisable to define degenerate nuclei of integral transformations, considering functions (2) to be eigenfunctions of these nuclei at different values of k.

Main part

For functions orthogonal with weight (1) can be rewritten as

$$T(t,\tau) = \rho(\tau)\sum_{n=1}^{\infty}\lambda_n\varphi_n(t)\varphi_n(\tau)\,. \tag{3}$$

Suppose $\varphi_n(t) = \dfrac{\sin^2\pi(t-n)}{[\pi(t-n)]^2}$, $\lambda_m = 1$. The orthogonality weight of these functions has the form

$$\rho(t) = 3 - 4\sin^2(\pi t)\,.$$

Based on (3), we have

$$T(t,\tau) = [3 - 4\sin^2(\pi\tau)] \sum_{n=-\infty}^{\infty} \left(\frac{\sin \pi(t-n)}{\pi(t-n)} \frac{\sin \pi(\tau-n)}{\pi(\tau-n)} \right)^2 =$$

$$= [3 - 4\sin^2(\pi\tau)] \left(\frac{\sin^2 \pi t + \sin^2 \pi\tau}{\pi^2(t-\tau)^2} + = \frac{2\sin \pi t \sin \pi\tau \sin \pi(\tau-t)}{\pi^3(t-\tau)^3} \right).$$

Suppose $\varphi_n(t) = \dfrac{\sin^3 \pi(t-n)}{[\pi(t-n)]^3}$, $\lambda_m = 1$. The orthogonality weight of these functions has the form

$$\rho(t) = \frac{20}{7} - \frac{24}{7}\sin^2(\pi t).$$

Basedon (3), we have

$$T(t,\tau) = \left[\frac{20}{7\pi^6} - \frac{24}{7\pi^6}\sin^2(\pi\tau) \right] \left\{ \frac{\sin^3 \pi t}{(t-\tau)^5} \left[\pi^3(t-\tau)^2 \cos \pi\tau - 3\pi^2(t-\tau)\sin \pi\tau + \right. \right.$$

$$\left. + 6\pi \cos \pi\tau \sin^2 \pi\tau \right] - \frac{\sin^3 \pi\tau}{(t-\tau)^5} \left[\pi^3(t-\tau)^2 \cos \pi t + + 3\pi^2(t-\tau)\sin \pi t + 6\pi \cos \pi t \sin^2 \pi t \right] \right\}$$

Similarly, one can calculate the kernels of transformations for the eigenfunctions described by expression (2) for any values of the exponent *k*.

The calculations performed show that the nuclei obtained in the considered manner are continuous.

Conclusion

The degenerate kernels considered, unlike the kernel that defines the space of functions in the basis of the count functions, are not cores that specify convolution. However, the practical implementation of devices that calculate such transformations is quite simple.

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Аннотация. В данной работе определяются вырожденные ядра гильбертовых пространств с воспроизводящим ядром. Собственные функции указанных пространств представляют собой целую степень функций отсчетов.

Ключевые слова: преобразования Гильберта, ортогональность, вырожденное ядро, собственная функция, базис.

Annotation. In this work, the degenerate kernels of Hilbert spaces with a reproducing kernel are determined. The eigen functions of the spaces are a whole degree of the sampling functions.

Keywords: Hilbert transforms, orthogonality, degenerate kernel, eigenfunction, basis.

CIRCULAR POLARIZED ANTENNA FOR MEASURING BUOY

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Introduction

The study of the large-scale circulation of the Black Sea waters has been carried out for a long time. Nevertheless, the task of studying the characteristics of currents in coastal zones, including in straits, continues to be relevant.

The economic and recreational significance, the ecological state of coastal zones, and the increasing anthropogenic pressure make it necessary to clarify the concepts of local systems of currents and to confirm the adequacy of the results of numerical modeling of water dynamics using experimental data arrays.

Various methods and technical means are used to measure the parameters of currents. Systems based on autonomous drifting buoys are actively used, which allow using direct instrumental measurements to determine the speed and direction of surface water flows [1].

Main part

The structure of the system, including coastal drifting buoys, is shown in (Fig. 1).
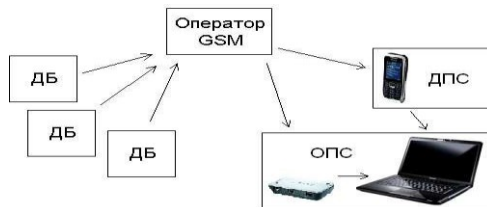
Fig. 1 – The structure of the system

The system includes [1]:
— surface drifting buoys (SDB);
— main receiving station (MRS);
— additional receiving station (ARS);
— GSM mobile operator.

For reasons of a high degree of mobility of the measuring buoy, an isotropic antenna with circular polarization is an ideal variant of the radiator, but for physical reasons of the impossibility of creating an ideal isotropic vibrator, an antenna with an omnidirectional radiation pattern in the horizontal plane, similar to a dipole, will be sufficient [2].

An antenna with circular polarization of the "clover" type was chosen as the emitter of the measuring buoy.

Fig. 2 shows a model of a clover antenna with four lobes.
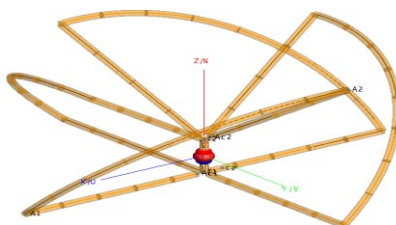
Fig. 2 – A model of a clover antenna with four lobes

The antenna contains from three to five radiating elements made of copper wire with a diameter of 1.5 mm.

The length of the rays is $\lambda/4$, and the arcs are $\lambda/2$, thus the total length of the lobe elements is equal to the wavelength λ. The distance from the feed point to each point of the arc is $\lambda/4$.

Data exchange will be carried out using GSM signals at frequencies of 1710-1880 MHz. In this range antenna is matched to the transmission line (Fig. 3).
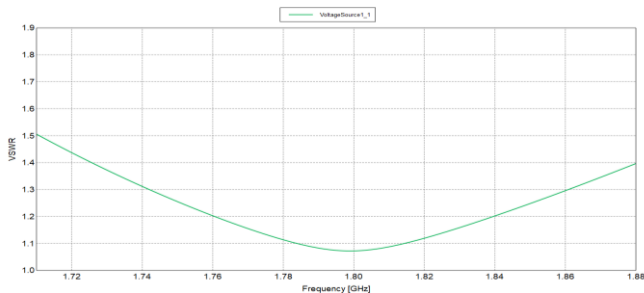
Fig. 3 – The transmission line

Conclusion

As a result of measurements, the following antenna characteristics were obtained:

— the coefficient of ellipticityis not less than 0.9;

— operating frequency range 1710-1880 MHz;

— input resistance 50 Ohm;

— standing wave ratio at the antenna input no more than 1.5;

— the width of the directional pattern in the azimuth plane – 360 °;

— the width of the directional pattern in the terrain angle – not less than 90°.

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Аннотация. В работе разработана и промоделирована GSM антенна типа «клевер» с четырьмя лепестками, которая может использоваться в составе измерительного буя.

Ключевые слова: GSM-связь, проволочная антенна, измерительный буй.

Annotation. In the work, a GSM antenna of the clover type with four lobes was analyzed and modeled, which can be used as part of a measuring buoy.

Keywords: GSM communication, wire antenna, measuring buoy.

UDC 621.396.67
MICROSTRIP DIRECTIONAL SLIT ANTENNA FOR WI-FI COMMUNICATION SYSTEMS

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Introduction

Microstrip slot antennas are well established for their broadband properties as well as their small size and ease of manufacture. They are widely used in wireless networks such as Wi-Fi, Wi-MAX, etc. A special feature of slotted printed antennas is radiation in two directions. However, to solve a number of technical problems, circular polarization radiation in one half-plane is required [1, 2].

Main part

The model of the developed microstripantenna is shown in Fig. 1.
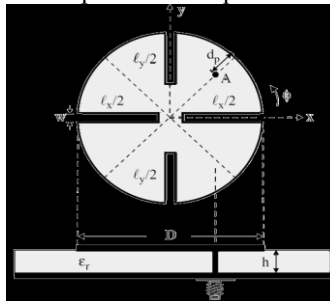
Figure 1 – The developed microstripantenna

Fig. 2 shows the radiation pattern at a frequency of 2 416 MHz and fig. 3 shows the radiation pattern at a frequency of 2 442MHz.
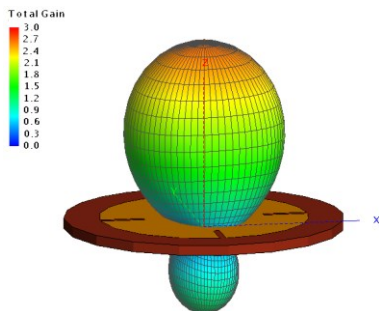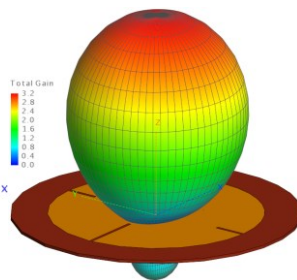
Figure 2.   Figure 3.

Fig. 4 demonstrates a graph of the standing wave ratio versus frequency.
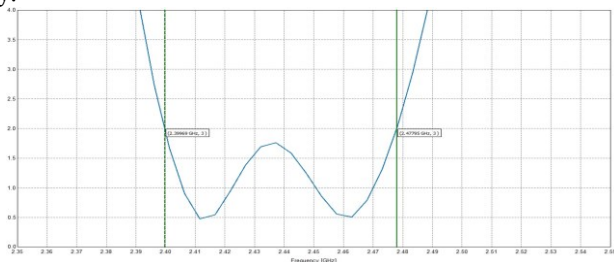
Figure 4

Conclusion

During the development of a microstrip circular polarized slot antenna, the antenna was simulated in the FEKO program and the characteristics of the antenna under study were obtained, such as:

— directional diagram;

— standing wave ratio;

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2.   Kin-Lu, Wong Compact and Broadband Microstrip Antennas. Wong Kin-Lu. Copyright by John Wiley & Sons, Inc., New York, Mar. 2004. Pp. 312-318.

Аннотация. В работе разработана и промоделирована антенна, работающая в Wi-Fi диапазоне частот 2,401-2,482 ГГц, с круговой поляризацией.

Ключевые слова: Wi-Fi системы связи, микрополосковая антенна, круговая поляризация поля излучения.

Annotation. In the work, an antenna operating in the Wi-Fi frequency range 2.401-2.482 GHz, with circular polarization, was developed and modeled.

Keywords: Wi-Fi communication systems, microstrip antenna, circular polarization of the radiation field.

CLIMATE CONTROL MODULE IN THE SMART HOME SYSTEM

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"Smart home" is an integration of household devices, communications and equipment used daily in everyday life into a single autonomous control system. The program is responsible for resource conservation and simplifies the management of the property, making life comfortable and safe.

In this article, we will consider the effective climate control system. inside the house, provided by a smart automated climate gear.

All climate, heating and ventilation equipment is centrally controlled by this system. The signals are collected in the central processor, which,

after processing according to the specified algorithms and settings of the smart home, issues control signals to all the equipment in the house. The intelligent system controls the house according to a given program, as well as remote control from mobile devices, which provides the ability to fix several scenarios that are most convenient for the owner in the device's memory. In order to save resources, it is possible to install heating or air conditioning of the room not around the clock, but in advance of returning home.

Smart home allows to organize full-fledged climate control. It is possible to regulate humidity, air temperature, air conditioning process, ventilation and other parameters by pressing one button. The complexity of such equipment lies in the preliminary development of a detailed plan. It is important to take into account all the features of the premises, the location of communications and other subtleties so that the system can fully function. In fig.1 we can see the connections of the "Smart Home" heating system.
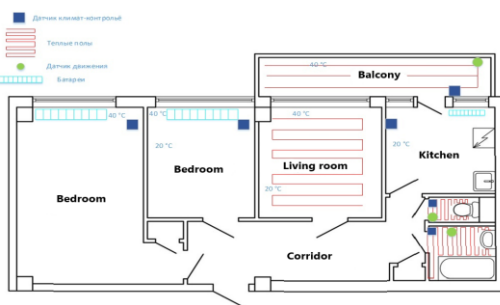
Figure 1 – Connection of the "Smart home" heating system

The climate control system includes the following main equipment modules:

1) Data capture sensors. These are CO2 gas sensors, temperature sensors inside the house and outside, pressure sensors, motion sensors.

2) The sensors are used to determine the algorithm for the operation of controllers associated with the server equipment of the smart home. Radio transmission flows from control systems to electric drives installed at collectors and radiators The radiothermostat gives the command for the valves of the heat transfer devices.

3) Ventilation and humidifying equipment is configured according to the wishes of the owners, the system adheres to the set settings. If necessary, air heaters with controllers will provide air heating of the premises. The supply and exhaust ventilation systems are fully controlled without human intervention, but according to the parameters set by them.

Air conditioners provide a microclimate in the premises, also based on the parameters of the control unit of the house.

4) The heating equipment is fully synchronized into a common system. Any opening of the window, blinds affects the choice of its actions. Also, it can perform these actions according to the algorithms laid down in the interfaces.

5) The data transmission system can be implemented in different ways, ranging from power grid and network cable, ending wirelessly. Usually digital systems are used, the basis of which a serial data bus, there is a separation of the interacting infrastructure from the power grid.

6) Computer centralized equipment allows to save information in an accessible form for users, provides data transmission over a distance and signaled dangers and other specified parameters. Also, the central processor ensures the minimization of energy costs due to optimized algorithms for specific user tasks. The router plays an important role in connecting all systems with each other. Data transfer flows through it precisely.

7) Information output devices and interfaces provide effective feedback to the host. In addition to the output panels, mobile devices are also used, and output on smartphones and tablets via mobile applications. As you can see, with the help of this system, it is quite possible to achieve flexible regulation of both the temperature inside a smart home and humidity, air circulation, air purification and achieve significant energy savings.

In conclusion it should be said that these smart systems can pre-heat your home before your return. They protect the heating system from freezing, which is a big advantage, because it is the worst thing that can happen to the heating of a building. It is worth noting that the computer support of climate systems can track weather changes via the Internet or barometric equipment, thus, the regulation of all settings in the house can be weather-dependent.

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2. Умный Дом управляет отоплением и следит за климатом [Электронный ресурс] URL: ttps://smarton.com.ua/funkcii_umnogo _doma/upravlenie_otopitelnimi_sistemami/ (дата обращения: 03.04.2021)

3. Отопление умного дома: устройство и принцип работы [Электронный ресурс] URL: https://sovet-ingenera.com/umniy-dom/otoplenie-v-umnom-dome.html (дата обращения: 10.04.2021)

Аннотация. Рассматривается система отопления, обеспечивающая автоматизированные климатические условия для

всего дома. Разработан алгоритм подключения системы климат-контроля. В настоящее время современная система «Умный дом» набирает популярность благодаря простоте управления всеми коммуникациями, такими как вентиляция, водоснабжение, отопление и даже бытовая техника. Все климатическое, отопительное и вентиляционное оборудование управляется этой системой централизованно. Современное отопление здания довольно разнообразно, все коммуникационные системы здания подчинены единой системе «Умный дом», которая представляет собой единый блок управления, связанный со всеми коммуникациями и оборудованием.

Ключевые слова: умный дом, отопление, климат-контроль, мобильное приложение.

Annotation. A heating system that provides automated climatic conditions for the whole house is considered. An algorithm for connecting the climate control system has been developed. Currently, the modern "Smart Home" system is gaining popularity due to the ease of managing all communications such as ventilation, water supply, heating and even household appliances. All climate, heating and ventilation equipment is centrally controlled by this system. Modern building heating is quite diverse, all communication systems of the building are subject to one single "Smart Home" system, which is a single control unit associated with all communications and equipment.

Keywords: Smart home, heating, climate control, mobile application.

UDC 621.372
SQUARE PRINTED EMITTING FOR RING ANTENNA ARRAY

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The developed printed emitter for KAR [1] was chosen because it has small mass-dimensional parameters and is well recommended in the frequency range 2.4-2.5 GHz. The model of the developed element was created in the Fekoprogram, the structure of the developed guide is shown in Fig. 1.

The emitting element is a two-layer structure. The emitter is located on the top substrate, and the 50-ohm line from the port is located on the bottom substrate. In the metallization on the upper side of the lower substrate, a slit aperture is cut in which the element is excited. In the process of calculating what is happening, it forms the parameters so that the element forms a radiation field in linear polarization and an input resistance of 50 Ohm, in the frequency range of 2.40 GHz. In Fig. 2, shows an element for a ring antenna array in the Feko program.
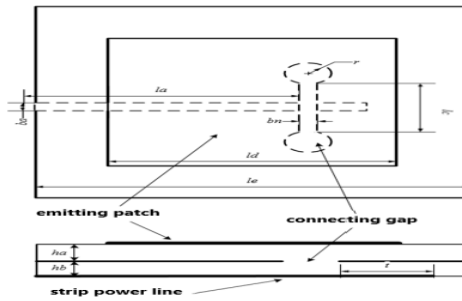
Figure 1—Element structure for a ring antenna array
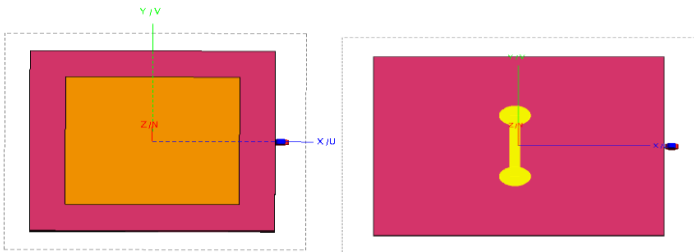
Figure 2—Element model for a ring antenna array in the Feko program

The printed antenna generates a radiation field in linear polarization and has an input impedance of 50 Ohm, in the frequency range 2.40 GHz are shown in Fig. 3. The value of the standing wave coefficient in the entire operating frequency range is not less than 1.5, which indicates a good approval with the supply line.
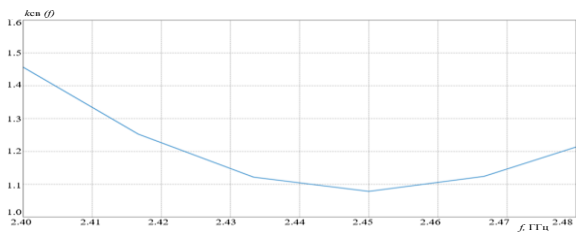
Figure 3 – Standing wave ratio versus frequency

The next stage of antenna calculations was the calculation of the radiation pattern. Fig.4 shows an orthogonal cross-section of the radiation pattern at a frequency of 2.4 GHz. It can be seen that the antenna in its operating frequency range forms an 85° wide beam pattern (at 2.4 GHz).

a)   b)
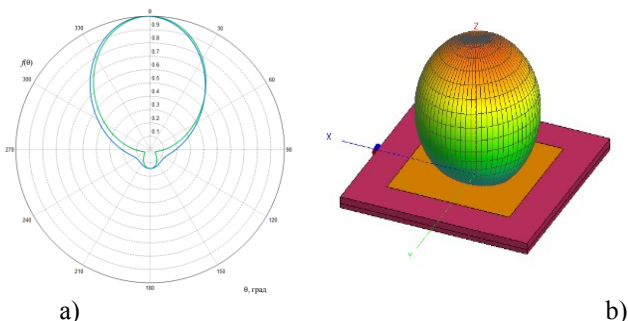
Figure 4 – Radiation pattern for the developed ring antenna array in two orthogonal planes (a) and 3D (b) at a frequency.

References:

1. Babaskin A.A., Kalinichev V.I. Modeling a Circular Antenna Array with Cyclic Phase Distribution on Elements. Journal of Radioelectronics, 2014.

Аннотация. Приведены результаты моделирования печатного излучателя круглой антенной решетки (АР) в диапазоне частот 2,4 - 2,5 ГГц, который может быть использован в системах беспроводной связи Wi-Fi. Он отличается сравнительно небольшими массогабаритными

параметрами и имеет направленное поле излучения, за счет чего увеличивается дальность беспроводной связи.

Ключевые слова: антенна, Wi-Fi, диаграмма направленности, элемент, печатный излучатель.

Annotation. The results of modeling a printed emitter for a circular antenna array (AR) operating in the frequency range 2.4-2.5 GHz, which can be used in wireless Wi-Fi communication systems, are presented. It is characterized by rather small mass-dimensional parameters. It has a directional radiation field due to which the range of wireless communication is increased.

Keywords: antenna, Wi-Fi, directional pattern, element, printed emitter.

UDC 621.372
RING ANTENNA ARRAY FOR REMONTE ACCESS TO WI-FI

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The antenna is one of the key elements of access points that determines the quality of the entire wireless communication system. One of the ways to implement antennas is a ring antenna array. The advantage of such arrays is that it is possible to shape the beam in a given direction quite effectively amplify the signal while suppressing spurious signals in other directions and providing full azimuth coverage of 360°.

Antenna array is a set of identical emitters, arranged in a certain order and excited by one or a set of coherent sources [2]. Compared to single antennas, the antenna array allows you to provide for a narrow pattern. The radiation fields of individual elements of the lattice interfere in space: in some directions the resulting field is amplified due to the in-phase addition of fields from sources, in others, on the contrary, it is weakened. In such antenna arrays, the location of the emitters can be different.

The ring antenna array considered in the report is constructed on the basis of a microplane emitter [1]. It consists of 9 radiating elements, which are arranged around a circle with a radius of 100 mm, Fig. 1. The antenna array has 9 ports that correspond to horizontal polarization.
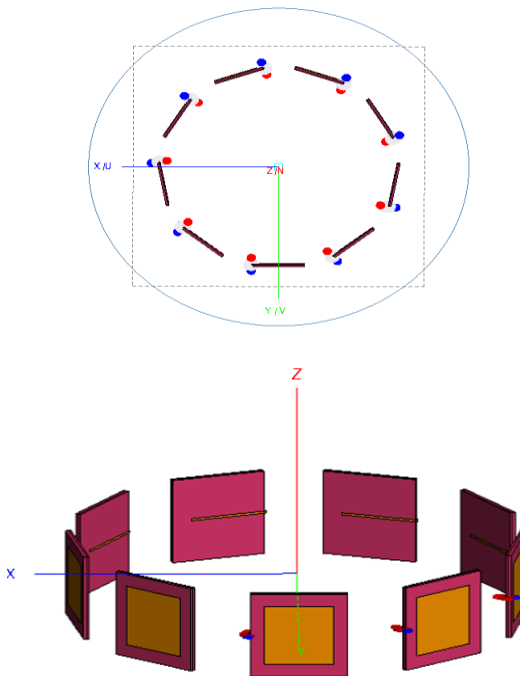
Figure 1 — Ring antenna array of 9 radiating elements

The grating was simulated by the same method as the emitting element [3]. Thus, in Fig. 2-3, of radiation patterns is presented, which can be obtained using two radiating elements in Fig. 2.
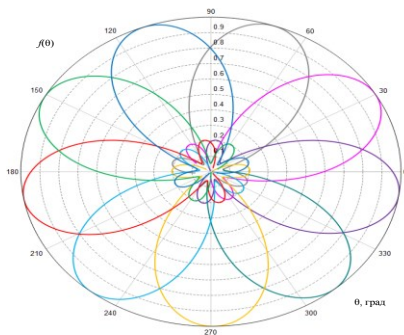
Figure 2 — Radiation pattern of a pair of emitters

A separate color in the figure shows the radiation patterns for the following pairs of operating emitters: blue - 1 + 2, green - 2 + 3, red - 3 + 4, blue - 4 + 5, yellow - 5 + 6, turquoise - 6 + 7, violet - 7 + 8, pink - 8 + 9, gray - 9 + 1 or three radiating elements Fig. 3, the figure shows pairs of working radiators: blue 1 + 2 + 3, green 2 + 3 + 4, red 3+ 4 + 5, blue 4 + 5 + 6, yellow 5 + 6 + 7, turquoise 6 + 7 + 8, purple 7 + 8 + 9, pink 8 + 9 + 1, gray 9 + 1 + 2.
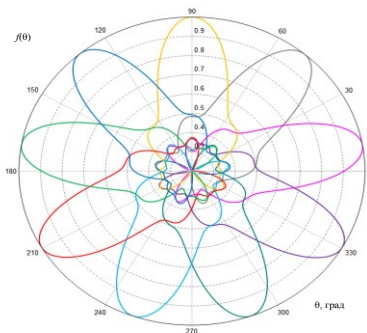
Figure 3 — Directional diagram of three emitters

In each case, the excitation of the lattice elements occurs in-phase. The antenna can form one of nine beams in the desired direction. It can be seen that the directional patterns intersect at a level of 0.7, that is, the antenna array allows scanning with the main beam of the directional pattern in the entire range of angles in azimuth. In this case, the coefficient of directional

action of each beam is slightly more than 8 dB in the case of two simultaneously operating emitters and is close to 10 dB with three emitters. However, the directional coefficient of each petal is higher than that of the previous one. Consequently, communication with the use of three lobes will be sought for a greater distance with the subscriber.

The ring antenna array can also work with several beams at the same time, if different Wi-Fi channels are used in different directions, since only two or three elements out of 9 are used to form the beam. However, the adjacent channels cannot work together, since they have one common emitter.

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Аннотация. Рассмотрена кольцевая антенная решетка на основе микроплоскостного излучателя, обеспечивающая полное азимутальное сканирование. Разработанная антенная решетка основана на девяти микрополосковых многослойных излучающих элементах. Приведены результаты расчета характеристик излучения антенны.

Ключевые слова: антенна, Wi-Fi, кольцевая антенная решетка, диаграмма направленности.

Annotation. An annular antenna array based on a microplane emitter that provides full azimuth scanning is considered. The developed antenna array is based on nine microstrip multilayer radiating elements. The results of calculating the characteristics of the antenna radiation are presented.

Keywords: antenna, Wi-Fi, ring antenna array, directional pattern.

UDC 665.71
SAFETY ASSESSMENT OF FILLING STATION OF ATAN NETWORK IN THE REPUBLIC OF CRIMEA

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Introduction. "KEDR" organization is a company specializing in the wholesale of solid, liquid and gaseous fuels. Petrol stations of ATAN company are located throughout the territory of the Republic of Crimea.

The company sells not only light oil products, but also dark ones, such as fuel oil, heating oil and bitumen.

Heating oil is used both in stationary steam boilers and in industrial furnaces. In a larger mass, as heating fuel, M 100 and M 40 fuel oil of petroleum origin are used. Fuel oil is used:

- as fuel for steam boilers;
- as fuel for boiler plants;
- as fuel for industrial furnaces.

The main part. The fuel oil yield is about 50% by weight, based on the original oil. In connection with the need to deepen oil refining, fuel oil is being further processed on an ever larger scale. For this purpose, distillates are distilled off under vacuum, boiling within the following ranges: 350-420 ° C, 350-460 ° C, 350-500 ° C and 420-500 ° C.

Vacuum distillates are used as raw materials for the production of motor fuel and distillate lubricating oils. The residue of vacuum distillation of fuel oil is used primarily for processing in thermal cracking and coking units. Also, the residue of vacuum distillation of fuel oil is used in the production of residual lubricating oils and bitumen.

Bitumen are solid or tar-like products, which are a mixture of hydrocarbons and their nitrogenous, oxygenated, sulfurous and metal-containing derivatives. The bitumens are insoluble in water. At the same time, they are completely or partially soluble in benzene, chloroform, carbon disulfide and other organic solvents. The density of such organic solvents should be between 0.95 g / cm³ and 1.50 g / cm³.

ATAN filling stations in the Republic of Crimea mainly specialize in filling vehicles with liquid motor fuel. However, there are also multi-fuel filling stations on the peninsula, which are designed both for refueling vehicles with liquid motor fuel and for refueling vehicles with gas.

The fuel range of petroleum products sold at ATAN filling stations is represented by:

– gasoline (Au98, Au95 ULTRA, Au95, Au92);
– diesel fuel (including ULTRA);
– liquefied petroleum gas (LPG).

On the territories of ATAN filling complexes, in addition to fuel dispensers, fuel storage tanks and an operator's building, there are branded cafes and shops.

The main area of safety assurance at filling stations is fire safety. The purpose of such measures is to prevent the occurrence and development of emergency situations, which are most often accompanied by fires [3].

Among the main sources providing the occurrence and accidents at filling stations of the ATAN network in the Republic of Crimea, the

following can be distinguished:

– storage a significant amount of flammable and combustible fuel at the filling station;

– high concentration of hazardous substances in a limited area;

– location several types of hazardous substances on the territory: gasoline, diesel fuel and liquefied gas;

– the availability of processes of periodic pumping of hazardous substances, which may provide the spillage of these substances;

– the availability of a large number of electrified equipment in close proximity to explosive and fire hazardous substances [2].

One should analyze additional, inherent only in the Crimean region, factors that increase the risk of occurrence and development of emergencies at filling stations of the ATAN network.

The problem of the safety of filling stations in Crimea can be exacerbated, first of all, due to hot weather conditions in the summer season. Recently, a shortage of water resources has been added to the trouble factors in Crimea, which can also negatively affect the solution of the problem of fire safety at gas stations.

The increase in population density and accelerated urbanization in recent years, after the annexation of Crimea to the Russian Federation, are also factors that indirectly exacerbate the problem of the safety of ATAN filling stations.

Another of the most significant emergency factors at ATAN filling stations is undoubtedly the militarization of the peninsula. This situation can give rise to damaging factors similar to the "powder keg" scenario.

Among the natural factors that exacerbate the problem of fire safety at ATAN filling stations in Crimea, it should be noted that the territory is more seismic. Constant small tremors of the earth's crust can have a destructive effect on underground fuel reservoirs, and the threat of a larger earthquake has been growing in recent years due to the cyclical nature of such natural processes.

And, finally, one should consider the factors that can pose a threat from the ATAN network filling stations not only to the life and health of people, but also to the Crimean ecosystems. Underestimation of such a Crimean factor can lead to an imbalance in the ecological situation in Crimea, a decrease in the value of the nature of the peninsula for recreation and tourism [1].

Conclusion. Thus, the network of ATAN filling stations which is widespread in Crimea should consider the climatic, political, ecological and socio-economic specifics of the peninsula in order to reduce the risks of occurrence and development of emergencies.

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Аннотация. Статья посвящена рассмотрению вопросов безопасности автозаправочных комплексов сети ATAN в связи с природно-климатической, политической, экологической и социально-экономической спецификой Республики Крым. Представлена деятельность автозаправочных комплексов сети ATAN на полуострове. Раскрыты факторы риска при их эксплуатации, меры по обеспечению пожарной безопасности.

Ключевые слова: автозаправочные комплексы сети ATAN, оценка безопасности, Республика Крым, факторы риска.

Annotation. The article is devoted to the consideration of the safety issues of filling stations of ATAN network in connection with the climatic, political, environmental and socio-economic specifics of the Republic of Crimea. The activity of filling stations of ATAN network is presented. Risk factors during their operation, measures to ensure fire safety are stated.

Keywords: filling stations of ATAN network, safety assessment, Republic of Crimea, risk factors.

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THE CONCEPT OF BUILDING AN INTERFERENCE COMPENSATION SYSTEM FOR SHIPBOARD SATELLITE RADIO NAVIGATION SYSTEMS

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Introduction

The development and widespread use of satellite navigation systems (SNS) has determined the urgency of "the problem of protection against interference of navigation devices of modern sea ships" [1, p. 8].

Full-scale research has not been conducted on the development of adaptive antennas for satellite navigation systems. At the same time, experts in the field of ship navigation are interested in such systems in order to improve the noise immunity of satellite navigation equipment in conditions of high density of radio equipment in navigable areas.

General and special noise immunity of the SNS

The problem of the general noise immunity of the space segment (SS) of satellite radio navigation systems (SRNS) and earth-based control and control systems of the SS is a problem of the States-owners of the SRNS.

From the point of view of the general noise immunity of the SRNS, the most vulnerable is the receiving radio navigation channel of the ship's radio navigation equipment (RNE) due to the low level of the useful signal coming to the RNE antenna. By definition, any extraneous signal above the level of-156 – -161 dBW (depending on the angle of arrival above the horizon), received on the isotropic antenna of the RNE, is a hindrance to navigation systems.

In known publications, as well as in numerous advertising brochures on RNE of mass use, the noise immunity indicator is not specified. This is probably due to the fact that the requirements for noise immunity to the equipment are possible only on the basis of the initial data on the interference situation in the application conditions. For a ground-based or airborne RNE, such conditions are very diverse.

A somewhat different situation arises for the task of special noise immunity of the SRNS in relation to the functioning of control and correction stations (CCS). As practice shows, in the region where the CCS

is located, it is not uncommon to use unlicensed radio equipment, the frequencies of which are in violation of the adopted laws and regulations. The suppression of even a single CCS can endanger the performance of its functions by numerous and responsible users.

The specifics of SRNS signals and interference

The features of receiving SNRS signals that determine the applied noise protection measures are the extremely low level of their signals at the Earth's surface (-160 dBW with the signal-to-thermal noise ratio S / N=-20 dB for open code S/A) and the code quasi-noise type of manipulation (CDMA in GPS and, respectively, FDMA in GLONASS). According to the standards of the US Federal Communications Commission (FCC), any signal above the noise level at the input of the RNE SRNS is characterized as interference and must be suppressed by filter, structural signal or spatial methods to levels that do not cause a failure in navigation or an unacceptable error in positioning.

According to the standards of the International Radiocommunication Union ITU, the power density levels of SRNS signals in the range from 1.525 GHz to 2.5 GHz at the Earth's surface should not exceed (-154) dBW / m^2 in any 4 kHz band, so as not to interfere with ground mobile communication channels operating in the same frequency area on a primary basis. The effective area of a weakly directed receiving communication antenna in the L1 range of the GPS SRNS is estimated to be of the order of (-25.4) dB / m^2. The GPS C/A code signal has a Ground level of (-160) dBW in the 1.023 MHz band. Therefore, the maximum microwave power density of the SRNS in the 4 kHz (34.1 dBHz) band at the antenna output will be W = (-160 - 34,1 + 25,4) dBW / m2 = - 168.7 dBW / m^2.

We see that the margin relative to the ITU standards is only 14.7 dB. For navigation spacecraft (NSC) of new GPS Block II projects with increased radiation power, the signal received by the RNO is (-157) dBW, i.e. 3 dB better than the old NCA projects and, consequently, this margin becomes less than 2 dB.This means that GPS receivers no longer have the opportunity to increase their signal stability due to the radiated power of the NSC, except for the correlation code processing-matched filtering in the equivalent narrow band of 1 Hz, when compression is implemented during processing up to 70 dB and the effective S/N ratio at the output of the RNE is from 38 to 42 dB.

So, further interference stability of the RNE can only be really provided by adaptation in the frequency and spatial domains.

Two-stage adaptation method

Despite the relatively well-developed mathematical general theory, the technical problem of noise immunity of the RNE and CCS of the SRNS

cannot be considered completely solved in practice. Thus, it suggested using the adaptive interference suppression (AIS) method for RNE responsible users and for CCS. The proposed method in the special technical literature has received the method of double or two-stage adaptation, conventionally called "adaptive-adaptive" and designated as A^2.

Fully adaptive mode as a special case of a finite automaton is a mathematical procedure that has the following feature [3, p. 106] – increased sensitivity of the algorithm in a linear approximation to the non-identity (non-ideality) of the elements.

Other disadvantages of the AIS mode also include such a phenomenon as distortion of the shape of the main lobe of the directional pattern (DN) when zero is formed for interference, which in practice also worsens the S/N ratio on its own signal. In some cases, when realizing structural selectivity, it is necessary to install a filter that "whitens" the interference structure, i.e., the implementation of the approximation of the interference structure to white noise, in front of the matched filter on the signal

The A^2 algorithm with a priori information about useful signals does not have a number of disadvantages of the AIS. The task consists in the synthesis of a quasi-optimal structure of a partially adaptive RNE for CCS SRNS with the maximum use of a priori information on signals and interference, i.e., it is reduced to finding the best algorithm for a given application.

Since such detailed a priori information can often not be available in practice, especially in the case of intermittent active interference, an adaptive A^2 processor is a reasonable alternative to building an (AB) SRNS with the required noise immunity in real conditions of positioning, navigation, and the development of corrective information in the CCS.

Processor A^2, strictly speaking, is a suboptimal structure with a preprocessor that solves the equation with a threshold – "presence/absence of a signal".

Consider the differences between the interference discrimination algorithms AIS and A^2.

Assume that there is a one-dimensional antenna array (AA) of N elements. Let X_{it}, where $=1,2,3…, N-1$ – samples of the electromagnetic field at the AA opening, and X - the sum of interfering interference and thermal noise: $X_{it} = J_{it} + N_{it}$.

Here: J_{it} – interference on the i-thelement AA at a point in time t; N_{it}- also for gaussian thermal noise.

The estimation of the spatial correlation function of the AA samples is expressed as:

$$\hat{R}_{(i-1)} = \frac{1}{R}\sum_{t=1}^{M} X_{it}X^{*}_{it},\tag{1}$$

where the sign $\wedge$ over R means the estimate, and M is the number of time samples.

As we can see, $\hat{R}_{(i-1)}$— this is the estimate of the first row of the covariance matrix using the SMI algorithm. Next, to estimate the coordinates of the interference, the full spatial spectrum from (1) is determined.

With the Gaussian character of thermal noise, the estimate of the location of the interference sources J is determined as follows:

$$\hat{X}^{j} = \frac{\sum_{j}(1/\sigma_j^2)\bullet(X_j - b_j)}{\sum_{j}(1/\sigma_j^2)},\tag{2}$$

Where X_j – interference coordinate, b_j—estimation bias, σ_j^2 – variance of the estimate.

It follows from (2) that in the AIS algorithm, in addition to the operations of determining the spatial correlation, matrix inversion, and angular spectrum over the entire antenna array opening (AA), it is also necessary to perform operations for estimating coordinates and their variances. In addition to hardware and computational costs, this leads to a mutual influence of interference suppression operations on the processing of useful signals, and, in particular, to distortion of the DP signals.

The general block diagram of the noise compensator according to the A^2 algorithm is shown in the figure 1.
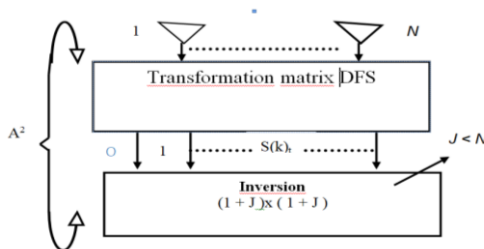
Figure 1 – Generalized scheme of the adaptive processor type A^2

The structure is based on an AA containing N inputs and J+1 outputs, where J is the number of interferences. The diagram-forming system (DFS) generates the main beam and J additional beams for interference. As a

result, the SMI device subtracts interference from the S/I mixture in the main beams.

Finding the interference angle in this case actually consists in a discrete Fourier transform (DFT) performed by a digital or analog DFS:

$$S\,(k)_t = \frac{1}{N} \sum_{n=1}^{N} X_{jt} \exp\left(-j\,\frac{2\pi}{N}\,nk\right). \qquad (3)$$

Then the estimate $\hat{U}\,(k)$ is found from (3) as follows:

$$\hat{U}\,(k) = \frac{1}{M} \sum_{t=1}^{M} [\,S\,(k)_t\,]. \qquad (4)$$

Here, as in (1), M is the number of time samples in the signal and interference band.

The accuracy estimate of the angular spectrum of the interference is obtained as:

$$\sigma_{\theta j} = \frac{\theta_3}{\sqrt{2M(J/N)_j}} \qquad (5)$$

Here θ_3—the width DP DFSantenna level of 3 dB, equal to $\lambda/(N+1)d$ in radians; $(J/N)_j$—the ratio of interference - thermal noise levels for the j-th interference at the output of the DFS.

Thus, the efficiency of A^2 in this first approximation is identical if the number of auxiliary beams is equal to or exceeds the number of interferences. At the same time, the A^2 algorithm provides significant savings in computing resources.

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Аннотация. Развитие и повсеместное широкое использование спутниковых навигационных систем (GPS, ГЛОНАСС, Galileo) определило актуальность проблемы защиты от помех навигационных устройств современного морского судна. Данная работа посвящена изучению особенностей приема сигналов спутниковых радионавигационных систем, представлена специфика сигналов и помех. В результате проведенных исследований авторы разработали меры помехозащиты, которые базируются на решении актуальной проблемы анализа и реализации методов устранения действия

источников электромагнитных помех разной природы. В основном это касается преднамеренных помех, устраняемых при помощи направленного и адаптивного подавления их полей излучения в области местоположения контрольно-корректирующих станций.

Ключевые слова: радионавигация, радиопомеха, компенсация радиопомех, адаптивна схема, навигационное оборудование.

Annotation. The development and widespread use of satellite navigation systems (GPS, GLONASS, Galileo) has determined the urgency of the problem of protection against interference of navigation devices of a modern marine vessel. This work is devoted to the study of the features of the reception of signals of satellite radio navigation systems, the specifics of signals and interference are presented. As a result of the conducted research, the authors have developed measures of interference protection, which are based on solving the actual problem of analyzing and implementing methods to eliminate the effects of sources of electromagnetic interference of different nature. This mainly concerns intentional interference that is eliminated by directional and adaptive suppression of their radiation fields in the area of the location of control and correction stations.

Keywords: radio navigation, radio interference, radio interference compensation, adaptive circuit, navigation equipment.

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MODERN MARINE DIESEL ENGINES

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Internal combustion engines are currently the main type of engines for commercial ships. Diesel engines are divided by design and by the organization of the work cycle into two-stroke and four-stroke. In addition, according to the number of revolutions, they are divided into low-speed (up

to 300 rpm), medium-speed (300-900 rpm) and high-speed (more than 900 rpm).

Diesel engines have been known for a long time and have developed in the direction of creating engines of greater power, necessary for high speed of the ship. Figure 1 shows the appearance and main components of a marine diesel engine of the RND 105 brand. This is a large eight-cylinder two-stroke marine diesel engine. Cylinder diameter-1050 mm; piston stroke-1800 mm; number of revolutions-108 rpm; engine weight-1175 t; thermal efficiency-41.5%; mechanical efficiency-91%.

The first marine internal combustion engines (ICE) appeared in the early 20th century. The Danish ship Zeeland, built in 1912, had a diesel engine with 2 diesels with a capacity of 147.2 kW each.

Currently, the main part of the main power plants installed on ships is made up of internal combustion engines.Steam turbine units have only ships with engine power from 14700 to 22,100 kW.A diesel power plant consists of 1 or more main engines, as well as the mechanisms that serve them.

Depending on the method of implementing the working cycle of the internal combustion engine is divided into 4-stroke and 2-stroke.

An additional increase in power is achieved by supercharging.

According to the speed of rotation of the internal combustion engine are divided into:

• low-speed diesels with a speed of 100-150 rpm, which directly drive the ship's propulsion system;

• medium-speed-300-600 rpm, which drive the ship's engine through the gearbox [1].

Until the end of the 1960s, the ships were equipped with reversible main engines, which allowed the ship to reverse. Only at low capacities, special devices (reverse gearboxes) were used to reverse the internal combustion engine, which make it possible to maneuver.

In the 60s, simultaneously with the advent of adjustable pitch propellers, they began to use non-reversible internal combustion engines as the main engine, first on small ships, trawlers and tugs, and then on large merchant ships. Due to this, the design of the engines was simplified. In addition to the main engine, there are 2 additional auxiliary engines that rotate the generators.

Auxiliary mechanisms and systems, as well as a system of pipelines and valves, are used to service the main and auxiliary engines. The fuel system is designed to supply fuel from the tanks to the engine.

At the same time, to reduce the viscosity, the fuel is heated and released from liquid and solid impurities in the separators and filters.

The lubrication system is used to pump the lubricating oil through the engine in order to reduce the friction between the rubbing surfaces, as well as to remove some of the heat received from the engine and clean the oil.

The cooling system is designed to remove heat from the engine, which mainly penetrates through the cylinder walls and occurs during fuel combustion, as well as to cool the circulating lubricating oil. This system consists of fresh and sea water pumps and water and oil coolers.

The launcher, which includes compressors, compressed air tanks, as well as pipelines and valves, is used to start the main and auxiliary engines.

Along with the above-mentioned auxiliary systems of the main and auxiliary engines, there are other general-purpose ship mechanisms in the engine room.

In a 4-stroke engine, the working cycle is carried out in 2 turns of the crankshaft, i.e. in 4 strokes of the piston.

Mechanical work is performed only during the 1st cycle, the remaining 3 are used for preparation.

At the 1st stroke, the piston moves in the direction of the crankshaft.

Under the influence of the resulting vacuum, air flows through the open suction valve into the cylinder.

In a diesel engine without supercharging, the intake air pressure is equal to atmospheric pressure, in a diesel engine with supercharging, pre-compressed air is supplied to the cylinder. During the 2nd stroke, with the suction valves closed, the pre-supplied air in front of the piston is compressed, thereby increasing the temperature and pressure.

The fuel pump, the drive of which is coordinated with the movement of the corresponding piston, increases the fuel pressure.

When the pressure reaches 19.62-39.24 MPa, the fuel is injected through the nozzle into the cylinder, in which the pressure of compressed air is 2.94-3.43 MPa and the temperature is 550-600°C, and in diesel engines with supercharged, respectively, 3.92-4.91 MPa and 600-700°C.
The fuel is injected shortly before the piston reaches the upper position.

The injected and carefully sprayed fuel in the compressed air is heated, vaporized, and together with the air forms a hot, self-igniting mixture. The 3rd clock cycle is a working one.

During the fuel combustion process, hot gases are formed, which cause an increase in pressure over the piston in non-supercharged diesels from 4.41 to 5.4 MPa, and in supercharged diesels - from 5.89 to 7.85 MPa.

Under the pressure of the force generated by the pressure of the gases, the piston moves down, the gases expand and produce mechanical work.

During the 4th stroke, the exhaust valve opens and the exhaust gases flow out. 4-stroke marine internal combustion engines are manufactured as

multi-cylinder engines. They are designed so that the working cycles are evenly distributed over the individual cylinders. The 1st stroke, called compression, begins when the piston is in the lower position [2]

The intake windows in the side walls of the cylinder are open. Pre-compressed purge air passes through these windows, the pressure of which must be higher than the pressure of the expanded gases in the cylinder. At the same time, the purge air through the open exhaust valve displaces the exhaust gases from the cylinder and fills the cylinder with a new dose. When the intake windows are closed by the piston, no air is supplied to the cylinder. Since the exhaust valve closes at the same time, the air in the cylinder is compressed. This process is not shown in the figure.

Fuel injection and ignition occurs in exactly the same way as in a 4-stroke internal combustion engine. During the 2nd cycle-the working (or expansion) – the expanding gases perform mechanical work. At the end of this stroke, the intake windows are opened by the piston and the cylinder purging process begins again. Exhaust gases can escape from the cylinder through an external valve, or through piston-controlled exhaust windows.

In two-stroke diesels, pre-compression of air occurs in centrifugal compressors, in the space under the piston, as well as in reciprocating compressors driven by the engine. The charge air pressure reaches 0.14-0.25 MPa. The figure below shows a cross-section of the main low-speed supercharged diesel engine.

The principle of operation of a low-speed two-stroke diesel engine: a-pre-compressed air displaces the exhaust gases from the cylinder; b-compression and suction occur simultaneously; c-working stroke and pre-compression; d-pre-compressed air displaces the exhaust gases from the engine cylinder without an output valve [3].

2-stroke diesels are manufactured in the form of multi-cylinder inline engines with 10-12 cylinders.The cylinder diameter of large 2-stroke diesel engines reaches 1000 mm, stroke – 1500-2000 mm. The power of the cylinder with a total engine power of more than 29,440 kW ranges from 2,900 to 3,700 kW.In this regard, the internal combustion engine can be used as the main engine on large ships. 2-stroke diesels are very large in size and weight. Their specific weight reaches 40-55 kg / kW. With a power of, for example, 14,720 kW, the mass is 600-800 tons.

Four-stroke diesels are used on ships either as part of diesel generator sets, or as the main engine in multi-shaft power plants (one diesel per one engine) and, accordingly, in multi-engine installations for one engine. The use of medium-speed diesels as the main engine provides the following advantages:

- increased reliability (when one engine fails, the rest continue to work);
- reduction of the dimensions and own weight of parts (for example, valves, pistons, crank mechanisms, bearings, etc.));
- reduction of the specific gravity, which, depending on the power, is from 14 to 35 kg/kW (for capacities of about 2200 kW).

Medium-speed diesels are also used in diesel-electric power plants as the main engine.

The main engines are placed in the engine room (MO) of the ship, usually closer to the stern, to reduce the length of the shafts that transmit the speed through the gearbox to the propeller. Figure 2 shows the placement of the main and auxiliary engines in the ship's MO.

Refrigerating unit-refrigeration unit; Steering gear-steering machine; Turbochargers – turbocharging units; Auxiliary engines-auxiliary engines; Generator-generator; Turbocharger-turbocharging unit; Air compressor - air compressor; Pumps-pumps; Main engine - main engine; Gearbox-gearbox; Shaft bearing-shaft bearings; Sterntube-deadwood pipe; Rudder carrier-rudderpost.

Recently, there have been trends towards switching to LNG as a fuel and cleaning up environmental emissions more thoroughly to meet the increasingly stringent IMO Regulations. This leads to the development of engines that use two types of fuel-diesel and LNG, with the transition in the future to engines that use only LNG as fuel, as a cleaner fuel. At the same time, in order not to install complex and expensive cleaning systems, as well as to reduce fuel consumption, ships are transferred to the "Slow Steaming" navigation mode, i.e. sailing at low speeds. This requires, in turn, the transition to low-speed engines.

When developing LNG-powered engines, two options are possible. When such engines are developed for LNG carriers, the liquefied gas is already on board, and it is necessary to use the vaporized (boil-off gas - BOG) gas as fuel. Then the gas supply system must provide gas from the cargo tank to the main engine and to the generators running on two types of fuel. The gas supply system must also provide for the supply of gas to the Gas Combustion Unit (GCU) in the event of high gas pressure in the tanks approaching the permissible limit value.

In the second case, for ships of other classes, such as container ships that do not carry LNG as cargo, both LNG tanks and a gas supply system from the tanks to the main engine and generators must be installed. In this case, there is a problem of designing space for LNG tanks without losing container cargo capacity.

From a technical point of view, there are only small differences between engines that use diesel and gas as fuel.

To control the engine that uses gaseous fuel, a special system is built into the engine design. In addition, the following components are added to the design of the main and auxiliary engines in addition to the gas supply system:

• ventilation system for ventilation of the inter-tube space in the gas supply system to the engine;

• sealing system for the diesel fuel supply to the separation valves separating gas and diesel fuel; this system is completely integrated into the engine by the engine manufacturer;

• inert gas system for purging the gas supply system to the engine with an inert gas;

• control system and safe operation system [4].

For the engines of LNG gas carriers, a system for re-liquefying the evaporated gas is sometimes needed. Brine circulation pump-salt solution circulation pump; Brine heater – salt solution heater; HP LNG pump-high pressure LNG pump; Optimizer-optimization device; LNG vaporizer – LNG evaporator; Pulse damper-pressure pulsation absorber.

In gas-containing tanks of the Mark III configuration, the principle of vaporized gas compression is different compared to the gas re-liquefaction systems of previous generations. Evaporated (boiled away) The gas (boil off gas-BOG) is removed from the LNG tanks by a three-stage centrifugal compressor, followed by cooling after each stage. Engines of the ME-GI line for container ships, gas carriers and bulk carriers.

In the coming years, there will probably be a gradual increase in fuel prices again, and engines running on two types of fuel will become quite profitable. And there, the transition to LNG-only engines is also expected.

For engines of the ME or ME-C line, it is quite possible to convert them to run on LNG. A large number of studies have been carried out by shipyards and classification societies, and currently, dual-fuel engine designs exist for ships of almost all classes. LNG tanks require 2-3 times more space than diesel tanks due to the low density of the gaseous fuel. In addition, these tanks require an effective thermal insulation system. The GI range of engines requires gas compressed at a pressure of up to 300 bar maximum. Gas liquefaction and regasification technologies are now available, and related technical solutions have been developed by HGS, TGE, DSME, Cryostar, HHI and now also MHI [5].

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Аннотация. В данной статье рассматриваются вопросы, связанные со строением современных судовых дизельных двигателей, Их историческим происхождением, и мощностными характеристиками судовых дизельных двигателей.

Ключевые слова: Дизельный двигатель, такт, морской, топливо, смазка.

Annotation. This article is devoted to the structure of modern marine diesel engines, their historical origin, power characteristics.

Keywords: diesel engines, stroke, marine, fuel, lubrication.

APPROXIMATION OF PULSE CHARACTERISTICS OF PHYSICALLY REALIZABLE FILTERS BY FUNCTIONS WITH A LIMITED SPECTRUM

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Introduction

It is a well-known fact that an ideal filter with a rectangular frequency response has a pulse characteristic, by shifting it by multiple time intervals, the sampling functions are obtained.

In the practical implementation of filters, the synthesis method is used for the specified transfer functions [1]. Using this technique, developers seek to create filters with an amplitude-frequency response (AFC), which has a shape close to a rectangular one. However, the filters obtained using the method [1] have pulse characteristics that, when shifted by multiple time intervals, do not form orthogonal systems of functions.

It seems relevant to consider the question of approximation of signals and pulse characteristics of physically realizable filters by functions with limited spectra.

The main part

To approximate the pulse characteristics of physically implemented filters, we will use a linear combination of functions of the form

$$\varphi_{mk}(t) = \frac{\sin^m b_{mk}\pi t}{(b_{mk}\pi t)^k},$$

Where b_{mk}- is the coefficient on which the width of the spectral density of the functions depends $\varphi_{mk}(t)$, $k \le m$, t- is the normalized time. Thus, the impulse response will be represented as

$$g_n(t) = \sum_m \sum_k a_{mk}\varphi_{mk}(t-n) =$$

$$= \sum_m \sum_k a_{mk} \frac{\sin^m b_{mk}\pi(t-n)}{(b_{mk}\pi(t-n))^k}.$$

The following speaks in favor of this choice. First, if $k \le m$, then the integrals of the product of any four functions $\varphi_{mk}(t)$ converge, therefore, for linearly independent functions $\varphi_{mk}(t)$, we can determine the weight of their orthogonality and construct an orthogonal basis from them. Secondly, all functions $\varphi_{mk}(t)$ have a limited spectral density. Third, the spectral densities $F_{mk}(j\omega)$ of functions $\varphi_{mk}(t)$ have the form of a polynomial in degrees ω. Figure 1 shows the result of the function approximation by the function:

$$g_0(t) = 1(t)e^{-t}\sin(t)$$

$$\tilde{g}(t) = x_1\frac{\sin^4 t}{t^2} + x_2\frac{\sin^2 t}{t} + x_3\frac{\sin^3 t}{t} +$$

$$+ x_4\frac{\sin^3 t}{t^2} + x_5\frac{\sin^5 t}{t^3} + x_6\frac{\sin^4 t}{t},$$

where $x_1 = -0,039$; $x_2 = -0,098$; $x_3 = 0,014$; $x_4 = 0,24$; $x_5 = 0,45$; $x_6 = -0,096$.
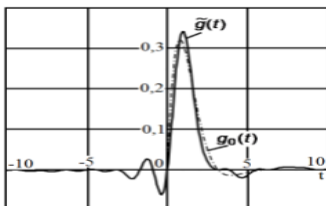
Picture 1– The result of the function approximation by the function

Direction for further research

In order to increase the rate of convergence of the sum (1), it is necessary to develop requirements for $\varphi_{mk}(t)$.

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Аннотация. Показано, что для аппроксимации импульсных характеристик физически реализуемых фильтров можно использовать функции с ограниченным спектром.

Ключевые слова: фильтры, ограниченный спектр, амплитудно-частотная характеристика, спектральная плотность.

Annotation. It is shown that, to approximate the impulse responses of physically realizable filters, one can use functions with a limited spectrum.

Keywords: filters, limited spectrum, amplitude-frequency response, spectral density.

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TRAFFIC JAM SENSOR

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1. Introduction

Nowadays traffic jamis a relevant and serious problem. Because of them, the road capacity is reduced. Idle machines increase fuel

consumption, and hence the release of harmful substances into the environment. Cars also make constant noise. No less important is the fact that due to traffic jams, drivers and passengers begin to stress, and thus increase the accident rate.

The appearance of traffic jams contributes to many factors, one of which is devoted to this work is the management of traffic flow. This is still the most accessible factor to eliminate, and for this purpose, smart traffic lights are used-part of an automated traffic management system. Currently, they are implemented using either cameras, or a variety of sensors, or combine both options.

Now the installation of all the necessary sensors is a costly event, and it must be carried out not at one, but at many traffic lights in order to get an advantage from the control obtained. This approach allows you to get a large amount of versatile information for processing.

2. Main part

It is proposed to use a budget equivalent instead of expensive redundancy. It is assumed that to control the traffic flow, it is enough to know its speed at traffic lights.

To measure the speed of traffic flow, it is natural to use a Doppler sensor, and install it at a traffic light (Fig. 1). However, in the case of a heavy traffic jam, the speed of transport will coincide with the speed of the stationary parts of the road, and there is uncertainty (Fig. 2). Therefore, together with the Doppler sensor, it is proposed to use a distance sensor.

Determine the required range of the distance sensor. The permissible road width for city streets according to GOST [1] is in the range of 3.0 - 3.5 m, and the distance between the road and the traffic light pole, where it is proposed to install sensors, is 0.5-2 m [2]. According to the same GOST, the distance to the "stop line" will be within 3.0-5.0 m. It is proposed to use an ultrasonic sensor, and according to calculations, its range should exceed 6 m. The AJ-SR04M ultrasonic sensor [3] has a range of 8 m.
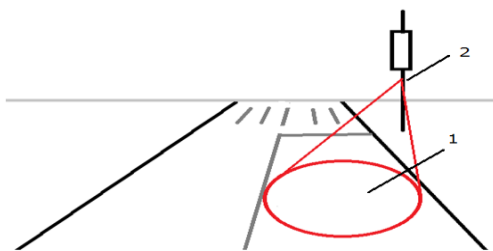
Figure 1 – Proposed sensor installation
1 – the operating range of the sensor; 2 – the placement of the sensor on the traffic light

Since the Doppler sensor is located at an angle, the speed calculated by it will not be the real speed of the car, an angle correction will be required. Given the different parameters, these calculations will have to be done separately for each traffic light. The uncertainty stated in Fig. 2 is solved by the algorithm in Fig. 3.
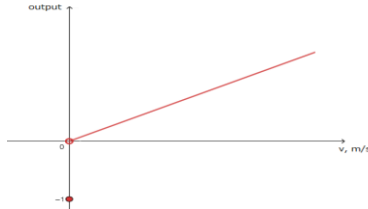
Figure 2 – Diagram illustrating the zero-speed problem
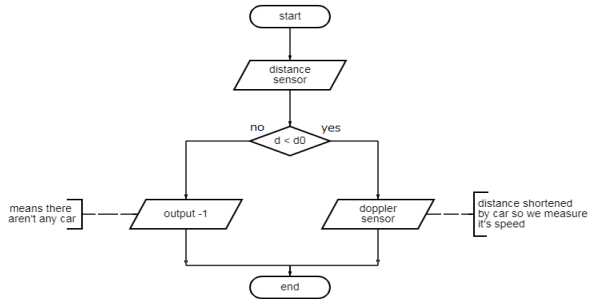
Figure 3 – Block diagram of receiving data from sensors

It is assumed that this speed value will be sent to the system responsible for setting the traffic light parameters. At any given time, the system will be aware of the speed of the traffic flow (Fig. 4), and will be able to use the available data for analysis.
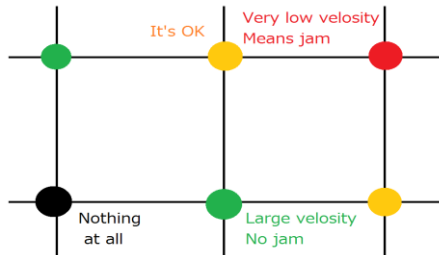
Figure 4 – Image of information in the control system

This combination of sensors is designed to calculate only the speed of traffic flow, since finding this parameter is enough to monitor traffic.

3. Conclusion

Thus, this article claims that the current implementation of the smart traffic light system is exaggerated. This can be considered as a promising direction for the development of the transport system of small cities. The possibility of simplifying the traffic flow control system requires further consideration.

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Аннотация. В статье рассмотрена проблема урегулирования пробок в городской среде. Рассмотрен основной фактор появления пробок, контроль которого позволяет добиться эффективного урегулирования движения транспортного потока и проанализирована основная причина, по которой данный метод не используется повсеместно. Предложен бюджетный вариант измерения тяжести пробок на основе скорости транспортного потока. Обнаружена и обоснована неопределённость при нулевой скорости транспортного потока, рассмотрена и обоснована реализация бюджетного решения на основе комбинации доплеровского датчика скорости и ультразвукового датчика расстояния.

Ключевые слова: пробка, измерение, датчик Доплера, скорость, траффик.

Annotation. The article considers the problem of dealing with traffic jams in the sities.The main factor of road traffic accumulation is considered. It's effective solution and the reason why it is not used everywhere are analyzed. The trouble of getting reasonable data from traffic with low or zero speed is considered. There doppler velocity sensor and ultrasonic distance sensor are introduced as a cheap way to get the information from traffic congestion. The usefulness of using velocity and distance sensor as a

budget-friendly way to solve the problem with traffic accumulation is substantiated.

Keywords: jam, measure, Doppler sensor, speed, traffic.

OMNIDIRECTIONAL WI-FI ANTENNA OF CIRCULAR POLARIZATION FOR BASE STATION

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Introduction

To organize the coverage area of a Wi-Fi network, both the structure of the network and the used equipment are important.

There are many custom antennas, but new antenna systems preferred to be developed and investigated that can improve the efficiency of power distribution in the range of coverage when there are various obstacles at the path of propagation. In this case, it is of interest to use an omnidirectional antenna with circular polarization and declination from the horizon line of the radiation pattern main lobe.

Main part

In some cases, to organize the range of coverage in the Wi-Fi network, antenna systems of base stations with an omnidirectional radiation pattern in the horizontal plane are required.

In this case, it is desirable to provide a slight declination of the directional pattern beam towards the ground.The authors of the paper have developed the modified four-way helical antenna [1]. For allspiral turns the initial and final winding angles of the spirals are differed. Figure 1 shows the main elements of the antenna design, as well as a three-dimensional model of the antenna as a whole.
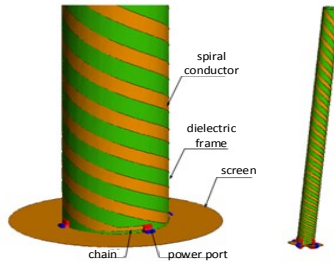
Figure 1 – The main elements of the antenna design

The figure 2 shows the normalized radiation pattern and polarization characteristic of antenna in the non-directional radiation mode with the upward deflection of the radiation pattern beam at a frequency of 2.45 GHz.
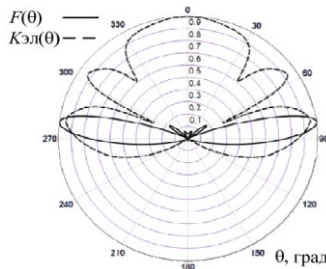
Figure 2 – The normalized radiation pattern with the upward deflection of the radiation pattern beam

The figure 3 shows the normalized radiation pattern and polarization characteristic of antenna in the non-directional radiation mode with the downward deflection of the radiation pattern beam at a frequency of 2.45 GHz.
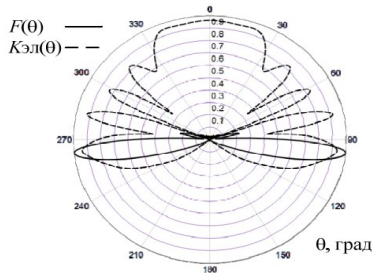
Figure 3 – The normalized radiation pattern with the downward deflection of the radiation pattern beam

The main conditions for creating a wireless channel over long distances are the good visibility between equipment installation points and no interference in the Fresnel zone. If there are obstacles in the Wi-Fi signal propagation path, its full or partial reflection, or absorption occurs. It depends on the material of the barrier, its structure, the presence of irregularities on the underlying surface and the Wi-Fi signal frequency.

In this case, the general electromagnetic field distribution in the coverage area will be determined not only by the shape of the base station antenna radiation pattern, but also by the polarization structure of the antenna radiation field. It is of practical interest to compare the field distributions in the coverage area created by the developed antenna [2] and the antenna with linear radiation polarization. The figure 4 shows the normalized radiation patterns of the developed antenna (4HHA) and linear polarized antenna array (LPAA) in the elevation plane.
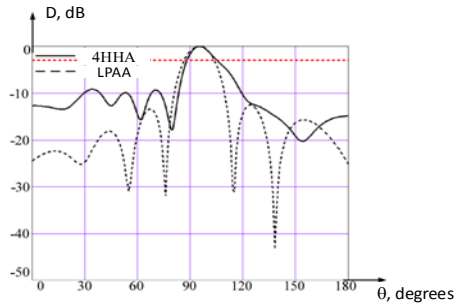
Figure 4 – 4HHA and LPAA

The figure 5 shows the signal distribution on the track with the metal obstacle.
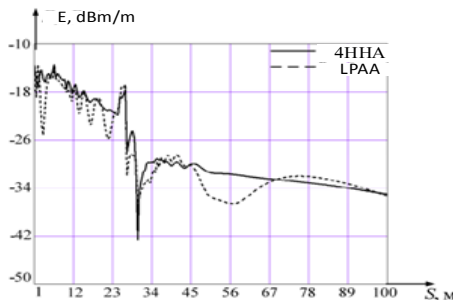
Figure 5 – The signal distribution on the track with the metal obstacle

The figure 6 shows the signal distribution on the track with the dielectric obstacle.
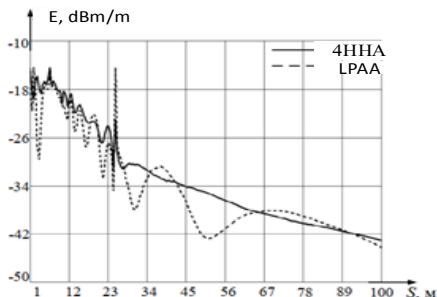
Figure 6 – The signal distribution on the track with the dielectric obstacle

Conclusion

It is stated that in the mode of non-directional radiation, due to the change in the geometric parameters of the antenna, the main beam of the radiation pattern can be deflected up or down from the horizon line.

It is shown that on a track with the obstacle, the field with circular polarization formed by the developed antenna provides the better signal distribution.

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Аннотация. В статье исследуется возможность управления лучом диаграммы направленности в режиме ненаправленного излучения в азимутальной плоскости для улучшения распределения сигнала в зоне покрытия при различных рельефах трассы.

В статье представлены результаты исследования распространения Wi-Fi сигналов линейной и круговой поляризации на пути с препятствием.

Ключевые слова: круговая поляризация, угол наклона, диаграмма направленности, диэлектрические свойства, антенная решетка.

Annotation. In the paper the possibility of controlling the directional pattern beam in the mode of non-directional radiation in the azimuthal plane to improve the distribution of the signal in the coverage area at various path topographies are investigated. The paper presents the results of a study of the propagation of Wi-Fi signals of linear and circular polarization on the track with various obstacles.

Keywords: circular polarization, tilt angle, radiation pattern, dielectric properties, antenna array.

UDC 621.396

THE USE OF ULTRASOUND IN THE STUDY OF DIGITAL RADAR SYSTEMS DURING UNIVERSITY WORKSHOP

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Introduction

Curricula in technical universities in a number of areas of training involve the study of the theory of radar and radar systems with digital principles of control and signal processing. In the implementation of practical training of students for the development of such courses, it is necessary to have laboratory equipment, specialized stands that provide research of radar systems for various purposes, the features of their functioning and the principles of information processing using modern methods of digital control and signal processing.

The main part

Modern radar systems are highly informative systems, have the most complex hardware and software. There are a number of directions for the development of modern radar technology. These types of radar systems require the deployment of large laboratory areas and significant material costs for universities. There are two main approaches to solving problems of modeling radar systems:

1. Mathematical modeling.

The most common method today is mathematical modeling, including radar systems. However, in mathematical modeling, the understanding of physical processes in location systems is largely lost. Mathematical models are extremely complex, and some mathematical models are difficult or even impossible to implement.

2. Physical modeling.

When considering the possibility of physical modeling of radar systems by replacing electromagnetic waves used in radar with ultrasonic waves, it can be stated that such a replacement is possible and is conditioned by the general physical nature of wave processes.

This analogy includes:

– linearity of propagation and constancy of the propagation velocity of both types of waves in a homogeneous medium;

– the repeatability of the phenomena of reflection, diffraction, interference, according to similar physical laws. An example of physical modeling is the developed ultrasonic location stand, the block diagram of which is shown in Figure 1.
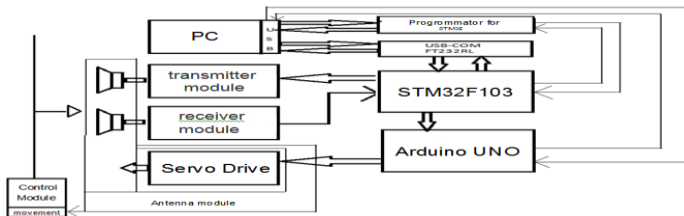
Fig. 1 – Block diagram of the stand

Let us consider the implemented physical model for modeling radar systems by ultrasound waves.

Two microcontrollers are used as microcontroller computers in the stand. The first is a 32-bit STM32F103C8 microcontroller used for signal processing. The second 8-bit microcontroller-ATmega 328, installed on the Arduino platform, is designed to control the position of the antenna in the azimuth plane(+-90 degrees). Probing signals for the operation of the transmitter (PRD) are formed programmatically by the first microcontroller, which, in turn, receives control commands from a personal computer (PC). The transmitting module (PRD) generates a probing signal and transmits it to a piezoelectric element located in the antenna module. A probing ultrasound message (8 periods at a frequency of 40 kHz) is radiated into space. The signals reflected from the targets are received by the receiving piezoelectric element, amplified in the receiving module (PRM) and transmitted to the microcontroller for digitization and subsequent

transmission of the array of samples to the computer for display and processing. To control the stands, a software package was used, including software development environments for controlling microcontrollers and a personal computer. C++ was used as the base language.

Figure 2 shows the view of the PC display when the stand is operating in sector view mode.
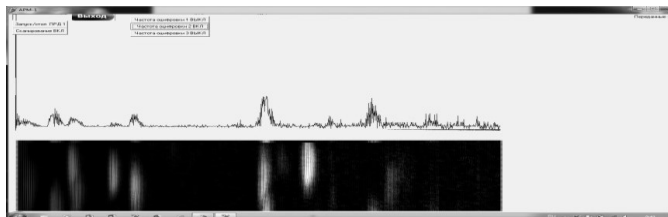
Figure 2 – Computer display when displaying information from the ultrasonic locator during research.

In the upper part of the screen there are controls for the operating modes of the stand (turning on / off the transmitter and scanning the antenna, changing the scale of the range and frequency of digitizing the primary signal). In the middle part of the screen, the current radar sensing line is displayed in the coordinates range (horizontal), intensity of reflection from targets (vertical). At the bottom of the screen, a two-dimensional brightness image of the test site space is displayed (the size of the test site is 2x4 meters) in the coordinates of the range (horizontal), the angle of rotation of the antenna (vertical).

Conclusion.

The developed and manufactured model of the ultrasonic locator has shown its full functionality and meets the requirements for it. The stand has a great modernization potential and allows you to simulate the operation of almost all known radar systems. With the help of the stand, students visually observe the physics of phenomena in location systems.

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Аннотация. В статье обоснован и показан пример практической реализации физического моделирования радиолокационных систем с использованием ультразвукового локатора, что повышает эффективность и наглядность усвоения принципов построения и эксплуатации современных цифровых радиолокационных систем.

Ключевые слова: лабораторный стенд, радиолокационная система, ультразвуковой локатор, программно-аппаратные средства, испытательный полигон.

Annotation. The article substantiates and shows an example of practical implementation of physical modeling of radar systems by using an ultrasonic locator, which increases the efficiency and visibility of mastering the principles of building and operating modern digital radar systems during the relevant courses.

Keywords: laboratory stand, radar system, ultrasonic locator, software and hardware, test site.

RADIOPHOTON BASE STATION FOR WI-FI NETWORK

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Introduction

Today, the Wi-Fi wireless networks are actively developing in the direction of increasing their bandwidth and data transmission security. Along with this, an important direction in the development of these networks is the issue of building branched networks with sufficiently large lengths of data transmission sections over closed communication channels.

Often, digital fiber-optic communication lines are used to organize the joint operation of base and central stations. However, for these purposes the researchesare being actively conducted on the use of analog fiber networks (Radio over Fiber), in which optical carriers are modeled by the radio signals. The main difficulty in building the base stations (BS) is the large dynamic range of the uplink input signal, which affects the probability of errors and the robustness of system detection.

Main part

A typical example [1] of incoherent detection is the direct detection method.

Figure 1 shows a schematic diagram of a typical Radio over Fiber line with direct detection.
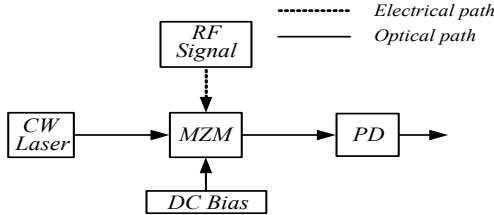
Figure 1 – Typical Radio over Fiber line

The advantage of the Direct Discovery Radio over Fiber link is its relative simplicity of structure and ease of implementation. The disadvantage of the channel is both low spectral efficiency and receiver sensitivity.

Figure 2 [2] shows an example of differential-coherent detection (DCD).
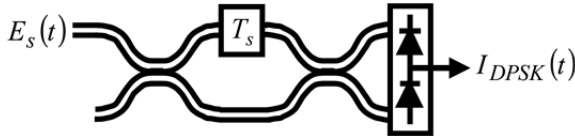
Figure 2 – DCD

The key sign for the DCD application is that BPSK has 2.8 dB higher sensitivity than an incoherent receiver at the Bit Error Rate (BER) of 10^{-9}.

Figure 3 shows an example of the hybrid of incoherent and differentially coherent detections. This method is used to recover information both in amplitude and in differential phase.
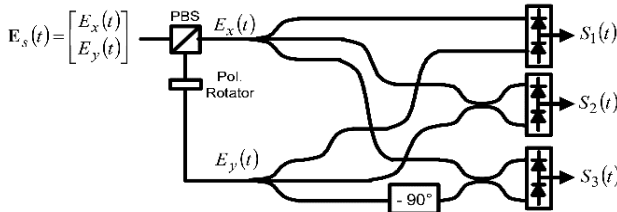
Figure 3. – The hybrid of incoherent and differentially coherent detections

The advantages of this solution are phase noise immunity and high receiver sensitivity.

Figure 4 shows an example of coherent detection with interferometric phase demodulation.
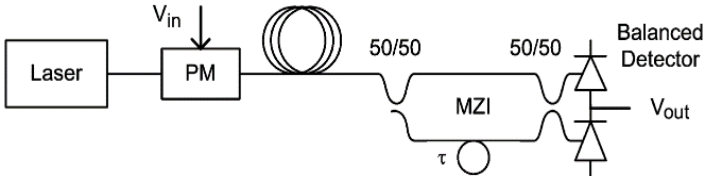
Figure 4 – Coherent detection with interferometric phase demodulation

The advantages of this solution are delayed self-mode detection and easy polarization control. The disadvantage is the limited system bandwidth.

We begin the development of the BS uplink [2] with the design of the simulation model, which will receive the small RF input signal from the BS antenna.

Figure 5 shows the circuitry for generating a low power RF input signal.

The other link in the circuit at Figure 5 is optical channel containing the phase modulator (PM) with phase deviation of 180°. A modulating RF signal is applied to the RF port of PM, and radiation from a laser diode (LD) with wavelength of 1550 nm and fixed power level of 7 dBm is applied to the optical port of PM.
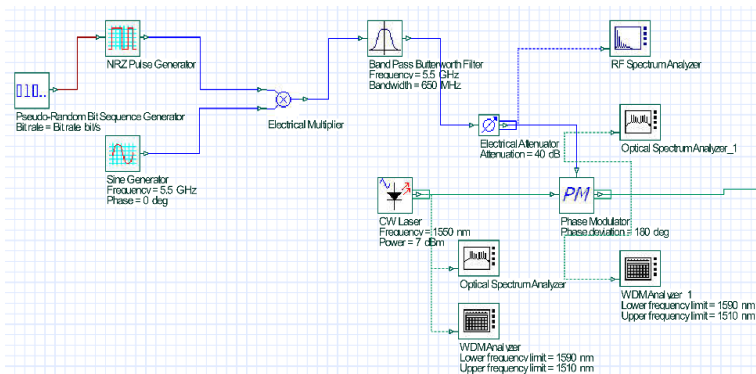
Figure 5. – The circuitry for generating a low power RF input signal

The phase-modulated optical signal is then applied to a 3 dB quadrature coupler (Figure 6). One arm introduces a time delay of 0.06 ns, and the other arm introduces a 90° phase shift.

Then, in the circuitry the optical signal is detected using the phase demodulator and next the subsequent construction of the "Eye-diagram".
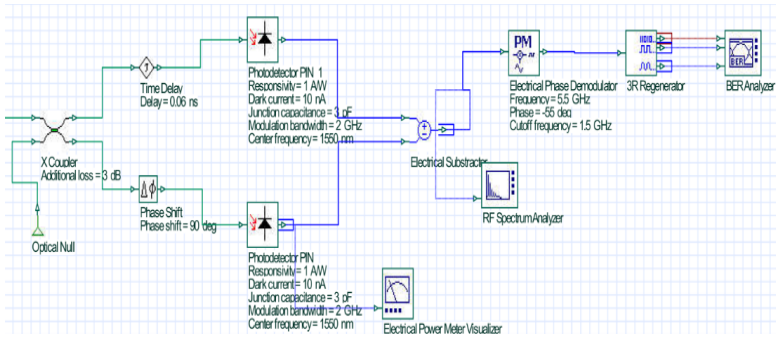
Figure 6 – The base station uplink

So the Figure 6 shows the simplified electrical diagram of the base station uplink.

Figures 7-8 show the "Eye Diagrams" versus the power level of the simulated RF signal for a single-channel fiber-optic communication system at data rates of 1.5 and 2.5 Gbps.

Conclusion

The comparative analysis of detection methods in optical communication systems is carried out. Outlined the advantages and disadvantages of each solution.
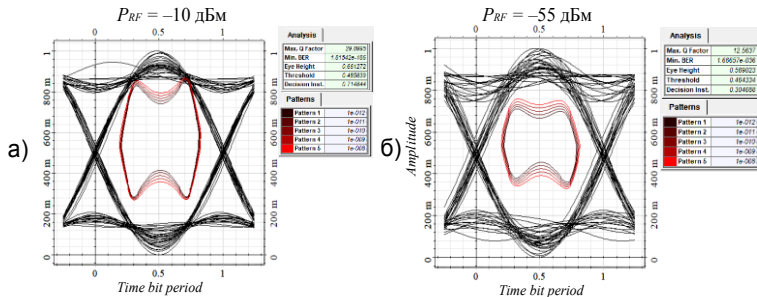
Figure 7 – "Eye Diagrams"
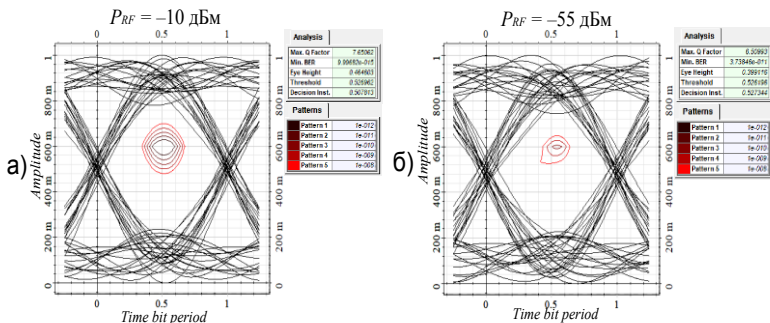
Figure 8 –"Eye Diagrams"

The method of coherent detection with interferometric phase demodulation is chosen for modeling.

The carried out studies have confirmed that the use of the coherent fiber-optic line communication in the uplink of the telecommunication system organized by Radio over Fiber technology, allows to significantly expand the dynamic range of the upstream channel and increase the receiver sensitivity.

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Аннотация. В статье сравниваются характеристики структурных схем для организации базовой станции восходящего канала для сети Wi-Fi с использованием технологии Radio over Fiber. Представлено, что использование когерентного детектирования позволяет повысить чувствительность приемника.

В статье представлены результаты разработки и исследования в системе автоматизированного проектирования (САПР) когерентной волоконно-оптической линии связи в восходящем канале базовой станции (БС) для беспроводной сети Wi-Fi, организованной с применением технологии Radio over Fiber.

Ключевые слова: радио по оптоволокну, сеть Wi-Fi, когерентная оптоволоконная линия связи.

Annotation. In the paper the characteristics of structural diagrams for organizing the uplink base station for the Wi-Fi network using Radio over

Fiber technology is compared. It is shown that the use of coherent detection makes it possible to increase the sensitivity of the receiver.

The results of the development and CAD research of the coherent fiber-optic communication line in the upstream channel of the base station for the wireless Wi-Fi network, organized using Radio over Fiber technology, are presented.

Keywords: radio over Fiber, Wi-Fi network, coherent fiber-optic communication line.

UDC 62-1/9

FUZZY‑ LOGIC‑ CONTROLLED SHUNT‑ ACTIVE‑ FILTER IN IEEE THIRTY‑ BUS‑ SYSTEM WITH IMPROVED‑ DYNAMIC TIME‑ RESPONSE

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1. Introduction

'Shunt-Active-Power-Filters (APF) are outstanding amongst other-gadgets for remunerating the harmonics and asymmetries of the mains-flows caused by nonlinear-loads [7]. SAPF goes about as VSI in parallel with the load to relieve the current-harmonics by infusing equivalent and inverse consonant substance at the PCC (point of commoncoupling) [8]. The-VSI of SAPF channel gives the concurrent harmonic-current moderation and receptive-power-compensation [6]. High-order-filters, for example, LCL and LLCL, have been as of late utilized with shunt APF to diminish the ripple harmonics and to couple shunt APF with the grid [2].

SAPF using momentary real and reactive-power-control topology to dispose of the responsive and symphonious part of flows drawn by the non-straight load to make mains current sinusoidal [8]. The motivation behind the SAPF is to create and infuse the proper current into the power framework to take out the load-harmonics and acquire the unit-power-factor. The reference flows of the channel are Department of EEE, SCSVMV University, Kanchipuram, Tamilnadu, India acquired by conservative-power-theory and developed utilizing the model-predictive-control switching calculation which is connected to the traditional-inverter [1]. In SAF PI controller is most commonly used and has the merit of good

control performance, robustness, simple algorithm, clear physical meaning of parameters, easy to implement and high reliability. But this method has relatively more rise time and settling time [5]. The conventional PID controller which was used for controlling the APF requires precise linear mathematical models, which are difficult to obtain and may not give satisfactory performance under parameter variations, load disturbances. Fraction Order PID is used in achieving optimum design of controller by taking into account five different design specifications for the closed loop system taking the advantage of fraction order parameter λ and u. The orders of integration and differentiation are respectively λ and u (both positive real) [4]. Proportional Resonant (PR) controller is the possibility of implementing certain harmonic compensation without requiring excessive computational resources. This controller is highly suited to operate with sinusoidal references like the reference used in Grid connected PV inverters [4]. Adaptive hysteresis current controller changes the hysteresis bandwidth according to the instantaneous compensation current variation to optimize the required switching frequency [1]. Sliding Mode controller is a non linear control technique and has the properties of robustness, accuracy and this controller is implemented to SAF to improve the dynamic performance [5]. FL-Controller which can give good results because of its performance under parameter variations and non-linear conditions.

Fuzzy membership functions which can be designed don't need complicated mathematical calculations. Recently a lot of work has been done in power quality and custom power problems in the distribution system arising from non-linear loads.

The exceeding writing does not deal with FL-Controlled SAF applied to IEEE TBS. The upsides of FL-Controllers over the conventional controllers are that it does not require an precise arithmetic-model. It can hold nonlinearity& additionally robust than the conventional PI or PID controllers. This effort represents a shunt-APF that utilizes a FL-Controlled for TBS.

2. System Description

The role of the SAF is to distribute harmonic-currents measure up to in greatness yet inverse in-stage to those harmonics that are available in the-grid. The schematic-representation of SAF is outlined in Fig.1.

Figure 2 outlines the schematic-representation of the SAF with FL-controller. The Fuzzy Logic tool is a mathematical tool for dealing with uncertainty. It is important to observe that there is an intimate connection between Fuzziness and Complexity.

The fuzzy logic controller consists of fuzzyfication, Fuzzy inference system and Defuzzification. The control action is determined from the

evaluation of a set of simple linguistic rules and the process of converting a numerical value to a linguistic value is known as fuzzification. The FL-controller requires the choice of membership function. The membership function should be chosen in such a way that they cover the whole universe of discourse and they overlap each other.

Figure 3 represents the block diagram of FL-controller. The two inputs to FL-controller are bus voltage (e) and change in bus voltage (de/dt) are given. The two inputs were related by member functions. Basically forty-nine rules are there. Based on the operation it will be used.
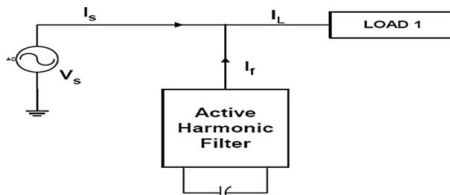
Figure 1 – Schematic—representationof SAF
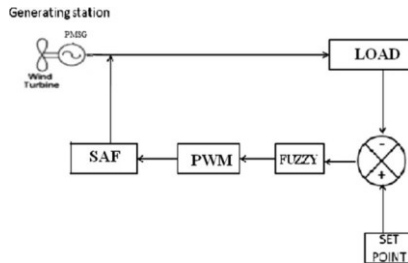
Figure 2 – Schematic-representation of the SAF with FLC

The switching signal for the PWM converter are obtained from comparing the actual source currents with the reference current. The output pulses are applied to switching devices of the PWM device. Actual current is compared with the reference current, and error is remunerated by FL-controller.

2. Proposed Work

The Basic disturbance which frequently occurs on the power system is load disturbance. Load disturbance effects both current and voltage of the grid or bus. Based on the rating of the inverter, grid whether the system can afford that load, load sharing and fluctuations will be settled in lesser time. Slight changes may not affect the system very much but heavy load changes affect the system. The use of the controller makes much difference in the system which severely influences the settling time, fluctuation of the

system parameters system stability. In this proposed work, a IEEE TBS with and without SAF, Closed loop PI based SAF and FL-C based SAF is modeled and change in load is given at bus-27 and the corresponding time domain parameters are measured. The one line diagram of IEEE TBS with and without SAF is shown in Figs. 4 and 5 respectively. This network consists of wind generator buses and load buses. The Annotation. This effort endeavors on improving the dynamic time-response of a Wind Energy Conversion System associated to IEEE Thirty-Bus-System (TBS) using closed loop controlled Active Power Filter with FL-Controller. This effort deals with modeling and simulation of IEEE TBS employing FL-Controller based Shunt-active-filter. The SAF is executed with VoltageSource-Inverter & the switching-pulses are created utilizing FL-Controller. In this proposed work open loop IEEE TBS with and without SAF, closed loop PI and FLC based SAF are simulated and the corresponding time domain parameters are given. The outcome represents that FL-Controller system has better response than PI Controlled Shunt Active Filter system. The contribution of this work is to improve the dynamic response of SAF–TBS using FL -Controllerloads are represented by the series connection of R and L. Each line is modelled by its series impedance.
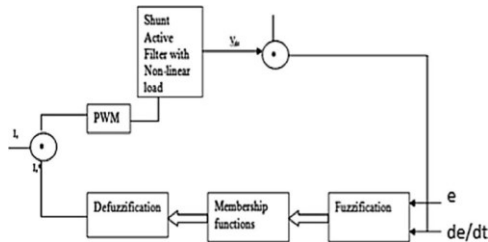
Figure 3 – Block diagram of Fuzzy Logic Controller
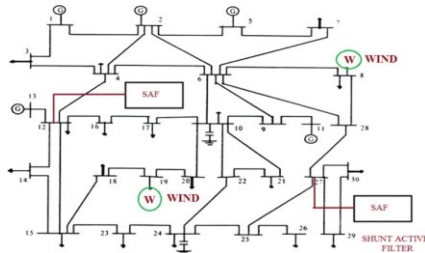
Figure 4 – One line diagram of IEEE TBS with SAF
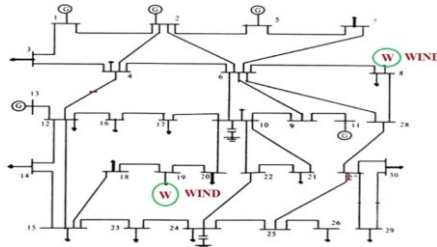
Figure 5 – One line diagram of IEEE TBS without SAF

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Аннотация. Рассмотрены улучшения динамического отклика системы преобразования энергии ветра, связанной с системой тридцати шин IEEE (TBS), с использованием управляемого активного фильтра мощности с замкнутым контуром с контроллером FL. Эта работа связана с моделированием и симуляцией IEEE TBS с использованием шунтирующего активного фильтра на основе FL-Controller. SAF выполняется с помощью инвертора источника напряжения, а импульсы переключения создаются с помощью контроллера FL. В этой предлагаемой работе моделируются IEEE TBS разомкнутого контура с и без SAF, замкнутого контура PI и SAF на основе FLC и даются соответствующие параметры во временной области. Результат показывает, что система FL-Controller имеет лучший отклик, чем система с активным шунтирующим фильтром с PI Controlled Shunt Active Filter. Вклад этой работы заключается в улучшении динамического отклика SAF – TBS с использованием FL - Controller.

Ключевые слова: управление с нечеткой логикой, шунтирующий активный фильтр, система из тридцати шин, динамический отклик, система преобразования энергии.

Annotation. The task of the paper is to consider improving the dynamic time-response of a Wind Energy Conversion System associated to IEEE Thirty-Bus-System (TBS) using closed loop controlled Active Power Filter with FL-Controller. This effort deals with modeling & simulation of IEEE TBS employing FL-Controller based Shunt-active-filter. The SAF is executed with Voltage Source-Inverter & the switching-pulses are created utilizing FL-Controller. In this proposed work open loop IEEE TBS with and without SAF, closed loop PI and FLC based SAF are simulated and the corresponding time domain parameters are given. The outcome represents that FL-Controller system has better response than PI Controlled Shunt Active Filter system. The contribution of this work is to improve the dynamic response of SAF–TBS using FL -Controller.

Keywords: Fuzzy‑ logic‑ controlled, shunt‑ active‑ filter, thirty‑ bus‑ system, dynamic response, Energy Conversion System.

UDC 502.08
THE DEVICE FOR COMMUNICATION THE PATIENT AND MEDICAL PERSONNEL BY VOICE

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1. Introduction

The urgency of the problem of calling a doctor by voice is the inability of people with disabilities for any reason to seek help, for example, after surgery. At the moment, there is only an option to activate the call using the button, which does not give a full opportunity to use this function for people with certain restrictions.

The aim of the work is to develop a device that allows patients in the hospital to interact with the medical staff through a voice assistant [1]. This device must contain a minimum of elements in order to avoid a system failure in the event of a failure of one of them. After analyzing the existing push-button call systems, it was concluded that the call display points used by medical personnel do not have the necessary portability, so it was decided to place the display and call unit in a compact case, convenient for transportation, for example, in the pocket of a doctor's dressing gown.

2. The main part

The algorithm of operation of this device is shown in Fig. 1 and is as follows: the patient asks to call a doctor → Yandex enables the server trigger alexstar.ru on your server → server alexstar.ru reads the change in the position of the trigger and sends a GET request to the Blynk server → the executing device reads the change in the position of the virtual button on the Blynk server and executes the internal code.

To ensure the required compactness of the device, the control board was modified and the circuit elements were selected so that they fit into the case. The battery is placed in this case and integrated on the printed circuit board along with other circuit elements.

Since the voice assistant requires an Internet connection, therefore, you need a device that provides a wireless Internet connection using Wi-Fi technology. For this purpose, a board with ESP82xx Node MCU was used, which has a built-in microprocessor, programmer, and stabilizer.
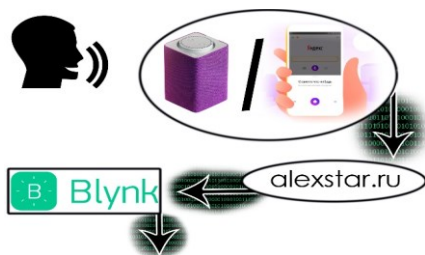
Figure 1 – The algorithm of operation

The case of the device is made using a 3D printer from PLA plastic, which is quite durable and environmentally friendly (Fig. 2). The inscriptions on the front side of the case are made with plastic paint. The thick walls of the case and the well-thought-out design provide maximum strength for this type of plastic.

Figure 2 – 3D printer from PLA plastic

Local debugging of the system consists in writing the necessary commands in a certain list located on the Yandex server. When using Yandex. Station as a device for patient interaction, it must also be configured to work with the local Wi-Fi network.

3. Conclusion

This device is easily integrated into the voice communication system if you have an Internet connection. Due to the relatively low cost, this device benefits from its analogues and can be available to almost any medical institution.

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Аннотация. Рассмотрен принцип работы устройства для коммуникации пациента с медицинским персоналом и разработан портативный блок индикации, взаимодействующий с голосовым помощником.

Ключевые слова: голосовой помощник, интернет вещей, микроконтроллер, медицина, Wi-Fi.

Annotation. The principle of operation of a device for communication between a patient and medical personnel is considered, and a portable display unit interacting with a voice assistant is developed.

Keywords: voice assistant, internet of things, microcontroller, medicine, Wi-Fi.

UDC 502.08

DEVELOPMENT OF A MICROSTRIP DIRECTIONAL COUPLER FOR AN INTEGRATED CONTROL DEVICE

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The built-in monitoring device under development is performed in a strip version. The total resistance sensor of the device contains several elements that produce two reference and two measuring signals. One of the elements that form the reference signals is a directional coupler. The built-in monitoring device was designed to operate at a frequency of 1.5 GHz.

The total resistance sensor, and, consequently, the directional coupler, was made in a strip design.For the construction of the directional coupler, the FR4 material with a thickness of 1 mm was used. Figure 1 shows a directional coupler diagram built in the AWR Design Environment CAD.
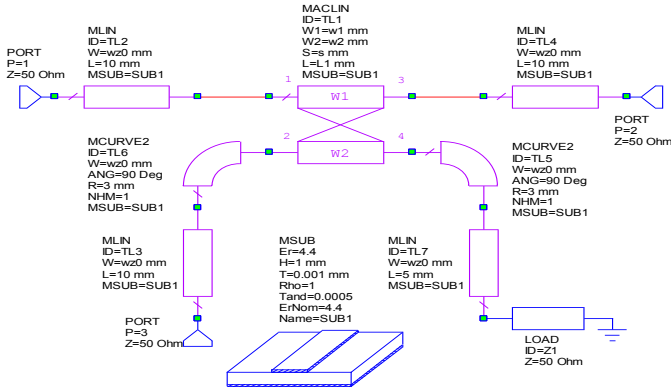
Figure 1 – Directional Coupler model in AWR
Design Environment CAD

Figure 2 shows the topology of the directional coupler. It is made on two connected lines with a gap of 0.25 mm and a connection length of 8 mm.
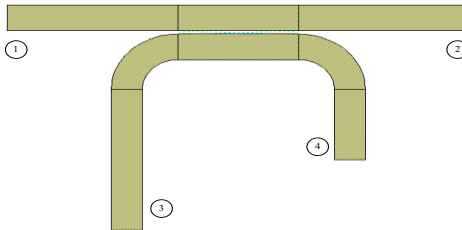
Figure 2 – Directional Coupler topology in the AWR Design
Environment CAD

The size of the gap between the two connected lines was chosen based on the possibility of implementing the directional coupler PCB manually. The bond length was chosen based on the requirement to obtain a transient attenuation at a level ranging from -17 dB to -20 dB. Input and output resistance of the coupler — 50 ohms.

Figure 3 shows the results of calculating the S-parameters of the directional coupler in the frequency range of 1.4-1.6 GHz. The graph shows that the directional coupler at a frequency of 1500 MHz provides a branch of the incident wave with a transient attenuation of 19.6 dB.
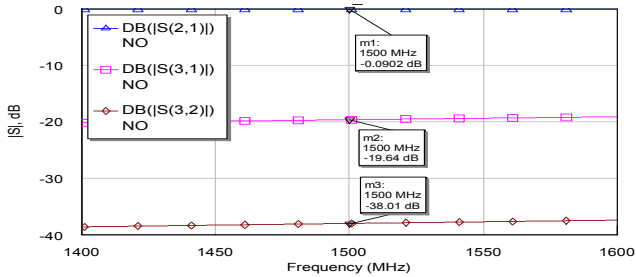
Figure 3 – Dependence of the S-parameters of the directional coupler on the frequency

In this case, the attenuation in the main track is not more than 0.1 dB. The isolation in the directional coupler is 38 dB. Hence, the directivity is 18.4 dB. Figure 4 shows the frequency dependencies of the SWR on each of the three directional coupler ports.
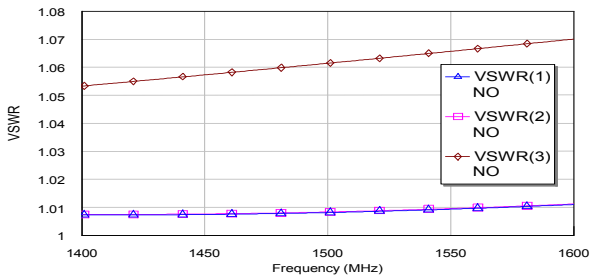
Figure 4 – Dependences of the VSWR at the outputs of the directional coupler on frequency

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Аннотация. На сегодняшнем рынке имеется достаточно большое количество измерительной техники, но использовать ее для постоянного контроля параметров довольно неудобно, так как зачастую это громоздкие стационарные устройства. Наиболее удачным решением является использование встраиваемых устройств контроля, которые не обладают универсальностью метрологических характеристик, но предназначены для контроля одного-двух параметров, изменяющихся в заданных пределах. Основные преимущества таких встраиваемых устройств – это небольшие геометрические размеры, требуемая точность измерения.

Ключевые слова: направленный ответвитель, входное сопротивление, частота, выходное сопротивление, элемент.

Annotation. There is a sufficiently large number of measuring equipment on the market, but it is quite inconvenient to use it to constantly monitor the parameters, as they are often bulky stationary devices. The most successful solution is the use of embedded control devices, which do not have the universality of metrological characteristics, but are designed to control one or two parameters that vary within specified limits. The main advantages of such embedded devices is the small geometric dimensions, required measurement accuracy.

Keywords: directional coupler, input resistance, frequency, output impedance, element

UDC 502.08
BROADBAND PRINTED ANTENNA WITH SLIT EXCITATION AND CIRCULAR POLARIZATION OF THE RADIATION FIELD

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There are many known methods for reducing the size of microstrip antennas at a given operating frequency. For the development of this antenna, a multilayer method and a slotted structure method were chosen. By using suitable slots in the radiator can be obtained a compact microstrip antenna [1]. The method for obtaining circular polarization was chosen, the method used in practice for most designs of MPA with a circular polarization field. The circular polarization field creates a single element of the emitter, the excitation is carried out at one point, chosen so that the amplitudes of the excited fields are the same, and the degeneration is eliminated by introducing a slight asymmetry into the antenna design [2]. One approach to increasing the bandwidth without complicating the antenna design is to use thicker substrates with moderate values of the dielectric constant of the material. The same widening of theworking band can often be achieved by modifying the shape of the radiating element.

Figure 1 shows the geometry of the model of a wideband microstrip antenna with an oblique nonlinear slit, for increased bandwidth, with circular polarization.

The non-linear connection slot in the ground plane is centered below the emitter and has a linear portion of the length S and two V-shaped slots with an end load equal to the length of the Sarm arm. This slit was chosen narrow (1 mm) and inclined relative to the microstrip line at an angle of 45°. The two V-shaped slots are perpendicular to each other and aligned parallel to both sides of the patch.

With the proposed nonlinear slot, the main resonant regime of a nearly square patch with a relatively large aspect ratio (greater than 1.1), can be divided into two resonant regimes with equal amplitudes and a phase difference of 90°, resulting in broadband circular polarization.If L > W, as shown in Figure 1, the antenna will radiate right-hand circular polarization.

The construction and calculation of the antenna was performed in CAD *Feko*.

The parameters were chosen so that the created antenna has broadbanding and formed a circularly polarized radiation field and had an input impedance close to 50 ohms in the frequency range from 1700 MHz to 2400 MHz.
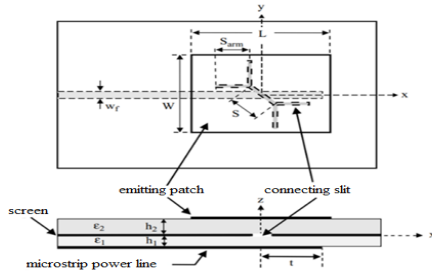
Figure 1 — Structure of a broadband microstrip antenna with a circularly polarized radiation field

To build the antenna model, we created: a dielectric substrate with a rectangular emitter; a dielectric substrate with a slit. The antenna is powered by a microstrip line located on the lower layer of the dielectric, which in turn excites V-shaped and nonlinear slits. Both substrates are made of FR - 4 dielectric.

The appearance of the antenna and the dielectric substrate with a slit are shown in figure 2.

а)   б)
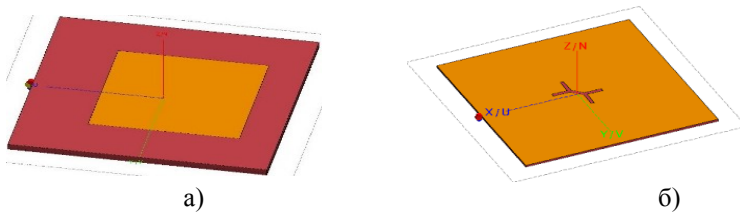
Figure 2 – a) appearance of the antenna; b) dielectric substrate with a slit
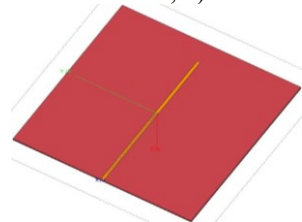
Figure 3 – Dielectric substrate with supply line.

Developed antenna in the entire frequency range forms a stable radiation pattern with a width varying in the range from56 (at 2400 MHz) to59°(at 1700 MHz).
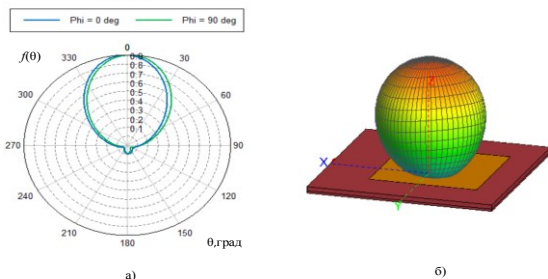
Figure 4 — The directional diagram of the developed antenna in two orthogonal planes (a) and 3D (b) at the frequency of 2050 MHz
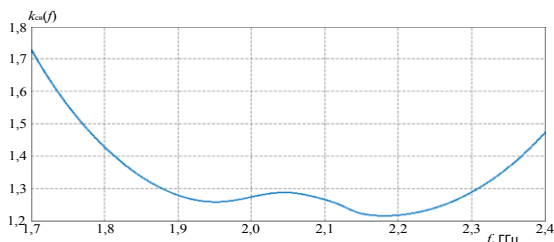
Figure 5 — Dependence of the standing wave coefficient at the antenna input on the frequency

In all the working range of frequencies the antenna is well matched - the coefficient of standing wave does not rise above the value of 1.7, the axial coefficient of ellipticity of the antenna radiation field does not fall below 0.9. Simulation of the matching device, which provides matching of the antenna with the supply line, was performed.

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Аннотация. Разработана широкополосная микрополосковая антенна с круговой поляризацией поля излучения на основе многослойной микрополосковой щелевой структуры. Было разработано согласующее устройство для согласования входного сопротивления антенны с линией питания. Приведены результаты расчета характеристик излучения антенны.

Ключевые слова: широкополосная антенна, микрополосковая антенна, круговая поляризация, полевое излучение, частота.

Annotation. A broadband microstrip antenna with circular polarization of the radiation field based on a multilayer microstrip slot structure has been developed. A matching device has been developed for matching the input resistance of the antenna with the supply line. The results of the calculation of the antenna radiation characteristics are presented.

Keywords: broadband antenna, microstrip antenna, circular polarization, field radiation, frequency.

UDC 502.08
LIGHTING CONTROL MODULE IN THE "SMART HOME" SYSTEM

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Smart home refers to a software and hardware complex that allows you to automate and simplify the management of various systems, as well as other equipment of the house or apartment. A smart system includes a set of sensors that monitor the operation of all connected devices. The information flows to a single control panel. The key element of the system becomes the controller. It collects and analyzes signals from all the sensors placed in the apartment. Its work does not stop for a minute [2-4].

The controller allows you to control all connected gadgets in real time, as well as schedule a delayed startup. It is enough to set the required parameters once, and the system will constantly maintain them. A complete list of functions of such a complex depends on the specific modification. Control of engineering systems functioning: heating, water supply and ventilation. Thanks to this it is possible to regulate the air temperature and humidity in the room, lighting and other parameters [1].

In this paper, we will look at the lighting of a smart home. Lighting control is one of the basic functions that are included in most standard smart home kits. But it can also mount separately. Then the program will carry the name "Smart Light". It has the following features:

1. Change the level of light in the rooms.
2. Automatic operation of the light switch with the onset of sleep time.
3. Control of exterior lighting of the building.
4. Switching on the light when a person enters the room.
5. Remote switching on and off of lights in individual rooms.
6. Remote control of the house power supply via the Internet.

Figure 1 – Philips smart lamps and control unit

The installation of such a system makes it possible to extend the service life of equipment and save energy. The functionality of smart lights can include the inclusion of backup power sources in emergency situations, as well as emergency shutdown of the entire network.

To create such a complex, you will need a controller, motion sensors, batteries. Smart lamps do not differ in appearance from conventional ones, but they have a module for automatic control.

Figure 2 – Philips golden glow lamp

To create such a system, Philips smart lamps and a control unit were chosen. The Hue Bridge control unit is the heart of the Philips Hue smart lighting system, which can integrate and control up to 50 lamps and accessories.

It can also be noted that with a smart lamp in the room you can create a unique color atmosphere, as there is control via Bluetooth.

The lighting control includes:

1. turning on and off home and landscape lights, standby and night lights, and backlighting devices on a specific schedule or on command from a touch panel, remote control, or motion sensors.

2. connection of light scenarios according to a given program: festive, duty, evening, etc.

3. automatic brightness control according to user settings.

4. detection of failures and malfunctions in the power grid, timely prevention of short circuits and overloads [5].

Fig. 3 shows the wiring diagram of the smart home lighting.
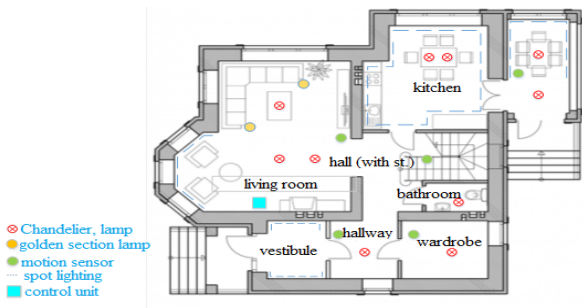
Figure 3 – Wiring diagram of the "smart" house lighting

When you control lighting with a remote control or touch panel, you ensure rational modes of operation of all lighting fixtures in the house.

When you leave the room, the light in the room will automatically turn off. The brightness level of the lamps will intelligently adjust depending on the time of day. In addition, you will be protected from dangerous and poor quality power supply thanks to the built-in voltage regulators. As a result, living will be as comfortable as possible. You will not need to perform the routine activities associated with turning on and off the light in the living and utility rooms. The automated process will greatly simplify your life. In addition, energy costs will be significantly reduced.

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Аннотация. Рассматривается «умный» дом – система автоматического управления и эксплуатации различных инженерных систем внутри и снаружи помещения. Сегодня умные дома достигли таких технологических высот, что их по праву можно считать автономными. Управление освещением регулируется разными методами, используются рациональные режимы, такие как автоматическое выключение света, уровень яркости лампы и безопасное электропитание. Ваше пребывание будет максимально комфортным, а автоматизированный процесс освещения значительно упростит вам повседневную жизнь. Кроме того, значительно снизятся затраты на электроэнергию.

Ключевые слова: умный дом, освещение, датчик движения, лампа, свет.

Annotation. As many people know, a "smart" house is a system of automatic control and operation of various engineering systems inside and outside the room. Today, smart homes have reached such technological heights that they can rightfully be considered autonomous. Lighting control is regulated by different methods, rational modes are used, such as automatic light off, lamp brightness level and safe power supply. Your stay

will be as comfortable as possible, and the automated lighting process will greatly simplify your everyday life. In addition, electricity costs will be significantly reduced.

Keywords: smarthome, lighting, motionsensor, lamp, light.

UNMANNED AERIAL VEHICLE FLIGHT CONTROLLER

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1. Introduction

The use of unmanned aerial vehicles (UAVs) is now becoming more and more relevant. A flight controller is used to control the UAV. Ready-made flight controllers consisting of a low-quality element base have a low cost and limited functionality, and controllers consisting of a medium-and high-quality element base with advanced functionality have a high cost [1]. The aim of the work is to develop our own flight controller for an unmanned aerial vehicle based on an element base of medium and high quality.The paper presents a block diagram of the UAV flight controller and considers the principle of its operation.

2. Main part

There are different types of UAV designs: rigid-wing (airplane-type UAV), flexible-wing, rotary-wing (helicopter-type UAV), flapping-wing, and aerostatic. UAVs with a rigid wing and with a rotating wing have a number of advantages: there are no complex body elements, it does not require much operator experience, a smaller amount of program code, and, accordingly, the acceleration of the microcontroller. Also, a small amount of program code allows you to use a microcontroller with a smaller amount of program memory, which reduces the cost of the device being developed. Based on the above, the main direction of development is the flight controller of these two types of UAVs. The UAV flight controller block

diagram shown in figure 1 consists of six functional components: the ATmega328P microcontroller (MCU); the NRF24L01+ transceiver (TR) [2]; the memory card (MC); the PCA9685 port expander (PE); the display (D) and telemetry sensors (TS), which include the MPU-6050 gyroscope and accelerometer, the HMC5883L magnetometer, and the NEO-GPS module. 6M, a BMP180 barometer that acts as an altitude sensor, an ambient temperature sensor, a battery voltage sensor, and a current sensor that uses the Hall effect.
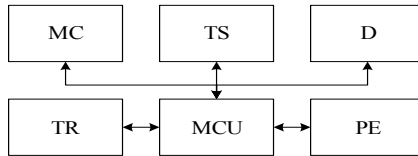
Figure 1 – The UAV flight controller block diagram

One should consider the principle of operation of the flight controller. The functional diagram is shown in Fig. 2. The microcontroller, which is part of the control panel of the unmanned aerial vehicle, collects data on the position of the potentiometers (control rudders) and, using a radio transmitter, sends the generated data packet to the radio receiver, which is part of the flight controller.
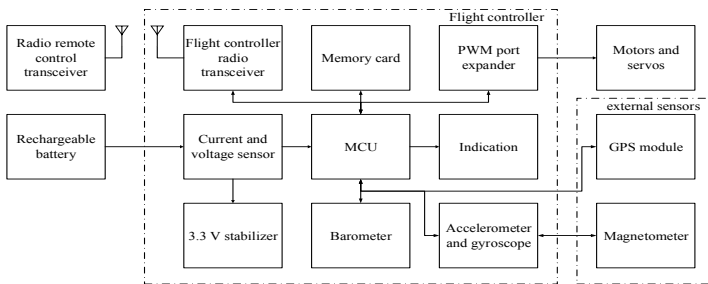
Figure 2 – The functional diagram

The microcontroller that is part of the flight controller receives and stores the received packet in the data memory. It then sends a request for orientation and coordinates in space to the peripheral sensors and stores the received response in the data memory. The microcontroller analyzes all the received data and calculates the necessary values of the speed of the motors and the deflection angles of the servos, forming a data package. It sends this packet to a port-expander chip with pulse-width modulation. The port expander generates signals at its terminals with a given frequency and duty

cycle, which control the speed of the motors and the deflection angles of the servos. The microcontroller generates a common package of all data generated during the last cycle of program code execution, and saves it to an external flash drive. From the data of all sensors, it generates a telemetry packet and, using a radio transmitter, sends this packet to the receiver of the control panel. The microcontroller of the control panel processes the received packet and displays the data on a graphical indicator.

3. Conclusion

The flight controller under development has the following distinctive features. The radio transceiver is integrated into the flight controller board, which will reduce the total weight of the electronic control unit, as well as increase reliability and simplify the operation process. The flight controller has a connector for a microSD flash drive. To control the motors and servos, a port expander with pulse-width modulation support has been added to the flight controller circuit, which will allow you to control sixteen motors or servos simultaneously.

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Аннотация. Рассмотрена проблема управления полетом беспилотного летательного аппарата. Разработана структурная схема контроллера полета беспилотного летательного аппаратаи рассмотрен принцип его работы. Приведены его отличительные особенности и достоинства перед аналогами, которые заключаются в том, что радио приемопередатчик интегрирован в плату полетного контроллера, что позволит уменьшить общую массу электронного блока управления, увеличит надежность и упростит процесс эксплуатации. Также предусмотрен разъем для flash-накопителя формата Micro SD. Для управления моторами и сервоприводами на схему полетного контроллера добавлен расширитель портов с поддержкой широтно-импульсной модуляции, что позволит управлять одновременно шестнадцатью моторами или сервоприводами.

Ключевые слова: полетный контроллер, обработка сигналов, радиоуправление, БПЛА, микроконтроллер.

Annotation. The problem of unmanned aerial vehicle flight control is considered. A block diagram of the flight controller of an unmanned aerial vehicle is developed and the principle of its operation is considered. Its distinctive features and advantages over analogs are given, which consist in

the radio transceiver is integrated into the flight controller board, which will reduce the total weight of the electronic control unit, increase reliability and simplify the operation process. There is also a connector for a Micro SD flash drive. To control motors and servos, a port expander with support for pulse width modulation is added to the flight controller circuit, which will allow you to simultaneously control sixteen motors or servos.

MOBILE VEHICLE STATUS CONTROL KIT

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1. Introduction

Nowadays, the problem of vehicle monitoring has become quite important. More and more large companies appear that are engaged in the transportation of passengers and goods within the CIS, to the countries of the near and far abroad. The fleet of cars and trucks is also growing. Naturally, long-haul flights are associated, to some extent, with risk, given that often transported goods are valuable and expensive. Therefore, the need for vehicle monitoring systems has recently increased markedly. The currently known vehicle monitoring systems "Global Tracer", "Orion" and "Mobitel", along with their numerous advantages, do not satisfy the consumer with the width of the covered control area of vehicles.

The purpose of this article is to develop a vehicle monitoring system capable of covering a wider vehicle control area.

2. Main part.

After conducting the research, a structural diagram of the vehicle monitoring system was selected (Fig. 1) using Thuraya satellite terminals [1].

The satellite allows to simultaneously support more than 13 thousand lines and communicate between terminals directly through the satellite, without the intervention of a ground gateway. With this in mind, a functional diagram of a vehicle monitoring system was developed (Fig. 2).

When choosing a schematic diagram, a modern electronic base was used. For example, an ATMega 8515 microcontroller from Atmel [2] was used as a sensor microcontroller.
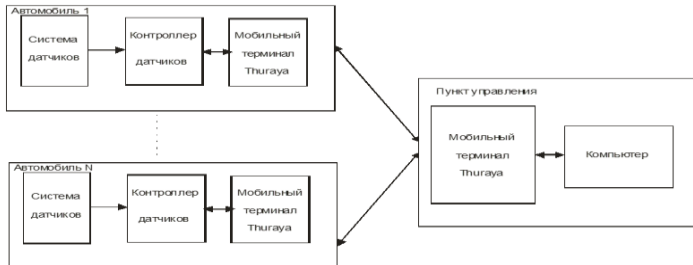
Figure 1 – A structural diagram of the vehicle monitoring system
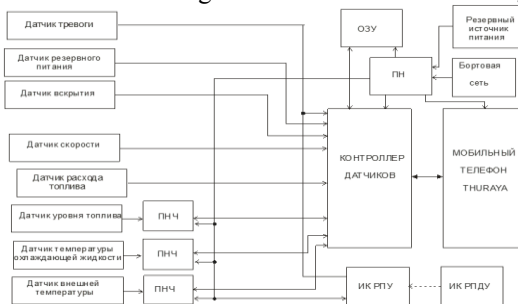
Figure 2 – A functional diagram of a vehicle monitoring system

When choosing it, the possibility of connecting an external RAM was taken into account and the maximum number of control points that this RAM can accommodate was calculated, in addition, the economic aspect was taken into account, therefore the ATMega 8515 microcontroller was chosen for the projected system, which is cheaper than ATMega 103, but has a complete set functions necessary for the operation of the system. Also used were: MST-8 speed sensor, fuel flow sensor, fuel level sensor, XR-4151 microcircuits manufactured by EXAR and temperature sensors LM335M and LM335H manufactured by National Semiconductors. The rest of the elements were selected for surface mounting.

The schematic diagram of the controller, indicating the location of the sensors, is shown in Fig. 3.
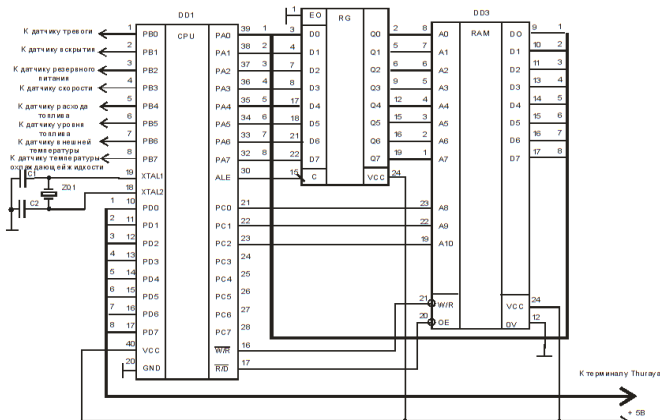
Figure 3 – The schematic diagram of the controller

3. Conclusion

Thus, a vehicle monitoring system has been developed.

Based on the research, a schematic diagram of the system was developed using Thuraya satellite terminals with an extended coverage area, which, in addition, allow determining the location of objects in real time.

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Аннотация. Была разработана и исследована система мониторинга транспортных средств, которая может охватывать широкую область управления транспортными средствами. В данной статье разработана и исследована принципиальная схема мобильного комплекта системы мониторинга транспортных средств. Основными элементами мобильного комплекта являются мобильный терминал Thuraya, обладающий широким набором функций, и сенсорный контроллер ATMega 8515, который принимает сигналы от сенсоров системы, обрабатывает их и сохраняет во внешней оперативной памяти. При разработке схемы были рассчитаны КЧХ датчиков уровня топлива и датчиков температуры и рассчитаны параметры сигналов на их выходах.

Ключевые слова: мониторинг транспорта, мобильные терминалы, «Thuraya», микроконтроллер ATMega 8515, датчики VFC.

Annotation. A vehicle monitoring system has been developed and investigated, which has the ability to cover a wide area of vehicle control. In this paper, a schematic diagram of a mobile set of a vehicle monitoring system was developed and investigated. The main elements of the mobile kit are the Thuraya mobile terminal, which has a wide range of functions, and the ATMega 8515 sensor controller, which receives signals from the system's sensors, processes them and stores them in external RAM. During the development of the circuit, the VFC of the fuel level sensors and temperature sensors was calculated and the parameters of the signals at their outputs were calculated.

Keywords: vehicle monitoring, mobile terminals, "Thuraya", ATMega 8515 microcontroller, VFC sensors.

SMART BABY TRACKER

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The development of a gadget for monitoring the health of newborns is a vital topic of research in the international scientific community. The age of one year is the most critical in lives of children. The future quality of life depends on the state of health during this period.

Nowadays, there is a huge number of different fitness trackers, smart watches and other gadgets which are very popular among adults, but such technologies are not suitable for babies. Many parents are too concerned about their children's health. This gadget will help parents to track the condition of their child in their smartphone. And it will be more convenient for doctors to collect anamnesis with such statistics.

Medical justification

Assessment of physical condition is an essential predictive indicator of child' shealth. This plays an important role in the diagnosis and prevention of various diseases and makes it possible to identify groups that are at risk. The main cause of diseases is the level of physical indicators that deviate from the norm. Physical development is the natural process of gradual formation and change of the forms and functions of the body, or, in other

words, it is the degree of maturation at each life stage. Therefore, the analysis is carried out in accordance with the age of the child. Several basic criteria, which can be used to assess the physical health of a person and in particular a child, were identified after a huge number of studies in medicine. For example, Body Mass Index (Quetelet's index), the Robinson index (reflects the functional capacity of the heart, it is measured by the number of heartbeats relative to active activity), the index of Skibinsky(shows the respiratory capacity of the lungs. It is calculated by the frequency of breaths per minute.). Also, if the body temperature rises, this indicates that a person becomes illand his body begins to fight a cold [1, 2].

Thus, based on the research of these scientists, we chose such indicators as Heart Rate, Number of breaths, Oxygen Content, and Temperature to assess physical health.

This device will be most effective for colds, respiratory diseases (asthma, pneumonia, bronchitis).

In the future, it is planned to provide the ability to notify the attending physician about a critical change in indicators through a mobile application.

Device configuration

Fig. 1 – The device

The prototype looks like a bracelet on which the device is attached, there is only a hidden power button without any light bulbs and a screen. An insulated wire leads from the main unit to the contact sensor. The contact on the finger is a rubber fingertip, which has an infrared emitter and a photodetector built in, similar to the structure of a standard pulse oximeter.
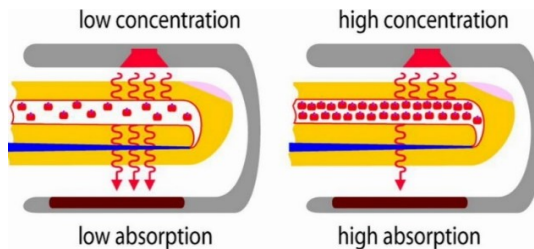
Fig. 2 – Pulse oximeter

Based on the experience of previous developments, as well as on the experience of communicating with a doctor working in the children's city hospital in the emergency department, we determined the set of sensors and the structure of the biomonitoring system.

Components:

- Thermometer
- Pulse oximeter (measures the pulse and oxygen level in the blood)
- Saturation sensor (measures the frequency of respiratory movements)
- Microprocessor (for converting measurement results to text)
- Bluetooth module
- Charging module

This sensor configuration is selected based on the following criteria:

- Measurements should be taken noiselessly and without vibration not to disturb the baby's sleep.
- The total volume used by the system should be minimal.

Two medical sensors-MAX30208 and MAXM86161 provide high measurement accuracy and these sensors are ideal for continuous monitoring of vital signs.

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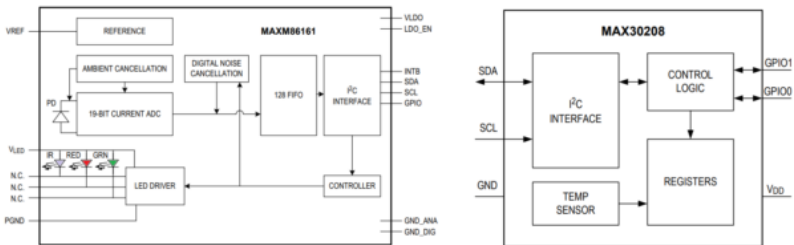
Fig. 3 – Medical sensors-MAX30208 and MAXM86161

The MAX30208 digital temperature sensor provides clinical accuracy of temperature measurement (±0.1°C). This sensor is able to quickly react to changes in temperature. The device also meets the strict energy consumption and size requirements of miniature devices, such as smart watches and medical sensors in the form of a patch.

The MAXM86161 effectively combats ambient light due to the industry's highest measurement accuracy. It consumes approximately 35% less energy than competing products, effectively extending the battery life of wearable devices.

The STM32WB55 wireless microcontroller is also used. This control microcontroller polls the sensors according to a set schedule and transmits data via Bluetooth to the mobile application.

Mobile application
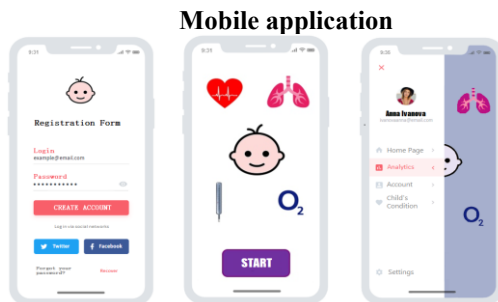
Fig. 4 – An application

The AndroidStudio IDE framework was chosen for mobile app development. We are also developing an AR application utilizing the Unity and Blender programs to make it more interesting to use.

At the first stage, the mobile app will allow you to monitor the indicators and adjust the measurement intervals.

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Аннотация. Статья знакомит с разработкой гаджета для мониторинга состояния здоровья новорожденных. Приведены примеры ключевых датчиков и индикаторов, используемых в данном устройстве. Также рассмотрен ряд болезней и отклонений от нормы здоровья, которые может распознать данный гаджет. Такой прибор будет очень полезен родителям, которые излишне волнуются за здоровье своего ребенка. В статье приведены веские аргументы важности и необходимости этого устройства.

Ключевые слова: треккер для ребенка, устройство, измерения, здоровье, медицина.

Annotation. This article provides information about the gadget for monitoring and predicting the condition of newborns. The article describes the main indicators this device is used for and the configuration of this device is presented in the paper. The key diseases defined by this gadget are also observed. This device is compared with temperature sensors. Smart

baby tracker is considered to be heplful for parents as the tool for successful parenting. The authors try to explain the relevance of this device.

Key words: baby tracker; device; measurements;health; medicine.

DEEP LEARNING APPROACHES FOR CANCER TREATMENT

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Introduction

Machine learning methods have got a wide integration into all spheres of human life in our days, because of its capability to solve a wide range of problems, classic programming methods can not manage with. In general it concerns the "Big data problem". It means that some issues can be solved if it is possible to analyze objects data and to structure it, or to make some conclusions according to given input. But some objects, we need to analyze, have so many properties, links, states and their combined variations that there is no such algorithm which we can apply to get necessary results. In these circumstances machine learning (ML) methods can save us. They applyspecial mathematical algorithms to extract necessary information from data, and eventually make a decisionbased on granted input (Figure 1).
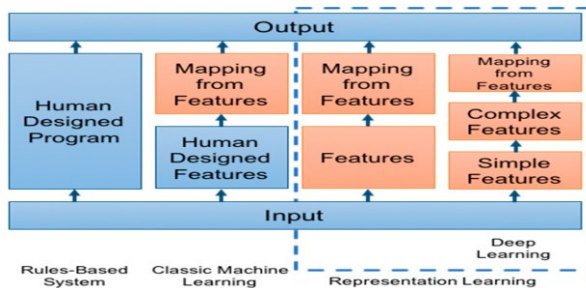
Figure 1 – Based ML working flow scheme

But the possibility of ML algorithms to give proper and well-defined object descriptions depends on how well all object features are represented in a given dataset (input), how well this dataset captures all features interconnections. By contrast, deep learning (DL) methods go further and

show better results of detection deep features links even if there is no predefined input. All of these methods are successfully used in different spheres of human life. For example, in medicine and especially in cancer recognition and treatment.

What is deep learning?

Deep learning is a subcategory of ML in artificial intelligence that use algorithms and models to learn from unstructured data without it special preprocessing [2]. This means that such approaches can extract information from the given features, analyze them, make patterns even without a given dataset; it is called unsupervised learning. Moreover, such methods can classifysuch information by learning wide rangeofsimple and complex features. Furthermore, DLNN are capable of detecting more abstract and unobviouscorrelations between features and data. There are a lot of types and architectures, Figure 2 describes the main concept. Each layer represents the amount of parameters and the neural network modifies these parameters in the process of learning to get the most accurate result. Image recognition which serves as a very helpful tool in cancer treatment can be done by convolutional neural networks (CNNs) – one of the DL NN types.
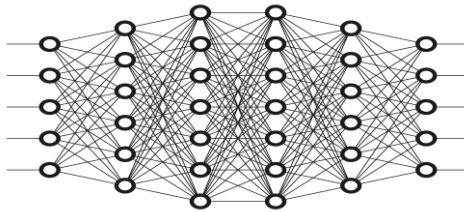
Figure 2 –Example of DL neural net architecture

How DL helps in cancer treatment ?

CNN approach is mostly used in image recognition practice because it shows most accurate results and highest efficiency. That is why these DL applications are applied for the field of glioma detection, characterization of it types, and making predictions for future treatment. Mostly it is necessary to pay attention on methods that candetermine burden of the disease, characterizeits particular qualities, and use imaging information to make expectations and prognosis. This task can be divided in the several subtasks: Pre and Post-Operative Tumor Segmentation, Characterization: Pseudoprogression and Radiogenomics and Prognostication.

Pre and Post-Operative Tumor Segmentation:

For estimation risks, forming prognoses and defining ways of both pre and post operative treatment it's necessary to have information about

tumors spreading and the general state of the damaged area. For these purposes simple radiographic monitoring is commonly used. But the main challenge takes place when it's necessary to segmentate areas of tumor spreading and distinguishing diseased and healthy places. It takes a lot of time or even can be impossible when cancer spreading is non-uniform and unpredictable. DL methods can help in this way and become a great approach. Using a great dataset of cancered brains images NN learns to find patterns of diseased area view and connections between different states of the tumors to make a prediction for the future spreading. For instance, Chen et al. created a NN for the necrotic and non-enhancing tumor segmentation. The result mean accuracy was 0.75 - 0.8. The NN was learnt with the use of 2017 BraTS data [1]. Moreover, such methods can predict possible postoperative scenarios according to found image pattern connections from different datasets.

Characterization: Pseudoprogression and Radiogenomics

During cancer treatment, it is often necessary to distinguish true disease progression (PD) and pseudoprogression (psPD) related to the treatment specifications. This process helps to estimate real prognoses and further treatment. The common method includes short-interval imaging and analyzing speed and manner of cancer spreading. The classic criteria show less accuracy than ML approaches. For example, RANO criteria was not enough efficient for accurate psPD cases determination. And Hu et al. demonstrated psPD classifier based on Support Vector Machine (one of classic linear ML methods) approach, which was learnt on MRI results dataset [1]. This model reached about 90% of accuracy and low mistake rate. For another example, Jang et al. decided to apply an approach, which was a CNN and ML combination. This model was CNN with algorithm of long short-term memory (CNN-LSTM). Such method represented remarkable results in psPDand tumor PD classifying. CNN-LSTM is a DL method with memory-clusters, a set of parameters used to find interconnections between current and previous states (Figure 3). This model shows results that are more accurate in comparison to pure ML or DL architectures.
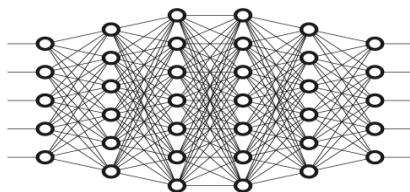
Figure 3 – Example of DL neural net architecture

Another one challenge, which can be performed by neural networks, is radio genomics – analyzing tumoral components, excluding, and profiling genetic features from them. Study and structuringof such features can lead to the therapy predictions accuracy increasingand its quality improving. In this case, NN can use data from images to characterize tumor subtypes. Levner's group was one of the first to apply this method in practice. They managed to achieve an accuracy of 87.7% among 59 patients sample [1]. Moreover, similar technique was successfully deployed to structure possible tumoral mutations using images of the brain.

Prognostication

Mentioned above methods help to make accurate prognosis for different cancer states. Various ML models are used to highlight disease hallmarks from the giving patient information datasets. The huge dataset and modern approaches help to identify cancer in the beginning when it can be easily treated. For instance, Zhang et al. reached great results in SVM usage for gliomas classification among 120 patients. They applied combination of SVM model and the Synthetic Minority Over-sampling Technique (it is ML technique, where abnormal class has better representation in training sample then normal one) and were able to achieveover 94% accuracy in gradingdifferent types of gliomas. SVM classifier also can predict general survival rate of patients with glioma, who are in preoperative stage. Emblem et al. explored such approach using rCBV (relative cerebral blood volume) of the tumor dataset. This group managed to achieve over 85% of accuracy and rather low mistake rate at 3 years of practice. Nie et al. applied DL and ML combined approach to this task and got 89% accuracy [1].

Conclusion

ML and DL approaches in cancer treatment have shown revolutionary results and development of its architectures can make this kind of disease not as dangerous as it was before. Now the main goals are: creating algorithms with higher generalizability to integrate these models in common clinical workflow and gathering and annotating more and more data for models learning which requires well-structured and representative datasets.

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Аннотация. Глубокое обучение описывается как подкатегория машинного обучения в искусственном интеллекте, использующая алгоритмы и модели для обучения на неструктурированных данных

без специальной предварительной обработки. Утверждается, что подходы ML и DL к лечению рака показали революционные результаты.

Ключевые слова: глубокое обучение, машинное обучение, свёрточная нейронная сеть, глиома, распознавание образов.

Annotation. Deep learning is described as a subcategory of ML in artificial intelligence using algorithms and models to learn from unstructured data without it special preprocessing. It is stated that ML and DL approaches in cancer treatment have shown revolutionary results.

Keywords: deep learning, machine learning, convolutional neural network, glioma, image recognition.

UDC 502.08
INDUCTIVE WATER CONDUCTIVITY SENSOR

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1. Introduction

The chemical composition of water is incredibly important for the study of the world's oceans, the development of natural resources, as well as the control and protection of the environment and the prevention of its pollution. Through studies of changes in wastewater, it is possible to record the emissions of harmful substances produced by large plants and factories. Drinking water is also analyzed.An important factor in the chemical composition of water is salinity - a measure of the content of various salts in water. Globally, changes in salinity may indicate melting glaciers, which are known to be composed of fresh water, as well as underwater currents that need to be taken into account when laying offshore routes and diving operations.

2. Main part

"The world ocean is the main part of the hydrosphere, covering almost 72 % of the planet's surface, includes oceans, seas, straits and bays" [1, p.14]. A distinctive feature of seawater is its salinity.Salinity(S) is the ratio of the mass of a dissolved solid in seawater to its mass,measured in ppm (‰). In the oceans, salinity is almost everywhere close to 35 ‰, but it is not the same everywhere. The following factors influence the salinity value:

— water evaporation;
— ice formation;
— precipitation that reduces salinity;
— flow of fresh river water;
— melting of the ice.

Water whose salinity does not exceed 0.5% is considered fresh water.

Salt water is unsuitable for drinking and most technical needs, which means that people's lives are largely determined by fresh water.

According to the public organization "Green Patrol", for the period from December 2020 to February 2021, Sevastopol ranks 76th, Crimea ranks 67th from 85 subjects of the Russian Federation in the environmental rating [2]. This indicator is an overall assessment of the state of the environment. Analyzing the previous reports, we can conclude that the environmental situation in the region is deteriorating.

Summary, monitoring and protecting the environment is a very important task for the region

Methods of measuring salinity.

Electrical conductivity is the ability of a medium to conduct an electric current; a property of the medium that determines the occurrence of an electric current in them under the influence of an electric field. Specific electrical conductivity (γ) — is a quantitative characteristic of the ability of water to conduct an electric current. This ability is directly related to the concentration of ions in the water. Conducting ions are obtained from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides, and carbonate compounds are the main chemical constituents of seawater. The number of ions is directly proportional to the value of the specific electrical conductivity of the liquid.

It is important to remember that the conductivity depends on the water temperature. The increase in conductivity is due to the fact that as the temperature increases, the viscosity of the liquid decreases and the thermal motion of the molecules increases. An increase in temperature can also lead to an increase in the number of ions in solution due to the dissociation of molecules. The dependence of the electrical conductivity of seawater on salinity, taking into account its temperature, is shown in Fig. 1 [3].
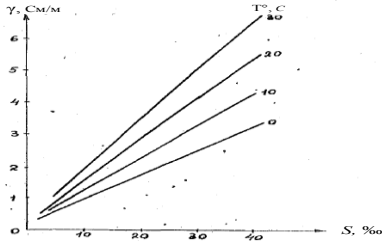
Figure 1 — Dependence of the electrical conductivity of
seawater on salinity

Discharges into rivers can change the conductivity depending on their composition. A faulty sewer system will increase the conductivity due to the presence of chlorides, phosphates, and nitrates; an oil spill will reduce the conductivity.

Principle of operation of the conductivity meter.

A feature of contactless conductometers is the absence of galvanic contact of the cell electrodes with the analyzed medium, which allows to control caustic, aggressive and abrasive solutions, as well as liquids that are prone to sticking of the sensor electrodes. The electrical conductivity sensor of this type consists of two inductively coupled transformers (inductors), between which the test water is located. The described device is called the primary converter. A schematic representation of a non-contact conductometer with a liquid coil is shown in Fig. 2.
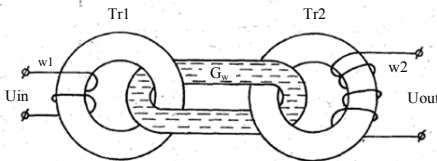
Figure 2 — A schematic representation of a non-contact conductometer

On each of the cores Tr1 and Tr2 there is one independent winding W1 and W2 with numbers of windings equal respectively to w1 and w2, and the cores themselves are connected by a coil of the tested liquid passing through the torus hole. Closed liquid coil, serves as a secondary winding for transformer Tr1 and a primary winding for transformer Tr2. As a result of electromagnetic interaction, an EMF is induced in the liquid coil and, as a consequence, an electric current, the conductors of which are anions and cations. The resulting current creates a magnetic flux in the winding of the

measuring transformer Tr2, causing an EMF in it, the value of which is proportional to the conductivity of the tested liquid.

The output voltage is defined as the multiplication of several parameters [4, p. 36]

$$U_{out} = U_{in} \cdot \mu_0 \cdot \mu_c \cdot (w2/w1) \cdot 2\pi \cdot f_{in} \cdot G_W \cdot (S_c/l_c).$$

Designations:

U_{out} — voltage on the measuring transformer winding;

U_{in} — voltage on the supply transformer winding;

μ_0 — magnetic constant;

μ_c — relative magnetic permeability of the core;

f_{in} — AC voltage frequency;

G_w — conductivity of the water coil;

S_c — core cross-sectional area;

l_c — the length of the magnetic field line of the core.

The specific electrical conductivity and electrical conductivity of seawater are related by the ratio

$$\gamma = \frac{G_W}{L_I},$$

L_I — is the effective length of the current lines that close around the sensor.

The effective length of current lines can be found from the previous equation at known values of specific conductivity and resistance of the water coil:

$$L_I = \frac{G_W}{\gamma} = \frac{\frac{1}{R_W}}{\gamma}.$$

The conductivity value of the liquid is converted to salinity according to the table of dependence of the specific conductivity of seawater on salinity and temperature.

Block diagram

The structural diagram of the inductive sensor is shown in Fig. 3., which includes: a supply (Tr1) and measuring coil (Tr2), forming the primary converter; generator (G), forming a low-frequency signal to power the primary coil; signal amplifiers (U1, U2); temperature sensor (TS) to adjust the conductivity depending on the temperature; power supply (PS), step-up converter (PC); microcontroller (MC), designed for signal processing.
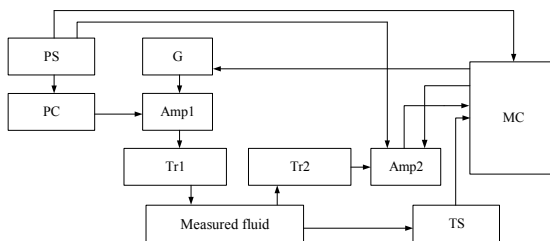
Figure 3 —Block diagram of device

The microcontroller sets the operating mode of the signal generator (frequency and amplitude). The signal from the generator, through the Amp1 amplifier, goes to the Tr1 coil. The principle of operation of the primary converter is described above. The signal from the coil Tr2 is transmitted via the amplifier Amp2 to the built-in ADC of the microcontroller. The microcontroller, by controlling the feedback of the amplifier, can change the gain of Amp2, for a more accurate detection of the input voltage in the low amplitude region.

Conclusion

A surface water salinity sensor has been developed. The developed sensor is based on the principle of measuring the conductivity of liquid and the subsequent recalculation of the obtained value into salinity.

Advantages of the method:high sensitivity;simplicity of the methodology;availability of equipment;possibility of examining stained and turbid solutions;rapidity of analysis;no contact with the test medium, which eliminates the contamination of electrodes and the formation of oxide films and deposits on them; resistance to caustic, aggressive and abrasive solutions.

Disadvantages of the method: low selectivity;sensitive to induction from external magnetic fields of the same frequency as the supply voltage.

The device under development has low power consumption and high measurement accuracy due to the use of a microcontroller and automatic adjustment of the measuring range of the medium conductivity.

The device can be included in the complex research apparatus.

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Аннотация. В статье рассмотрена проблема измерения солёности поверхностных вод, проведён анализ причин изменения солёности, как одного из ключевых параметров, указывающих на изменение состава воды. Проведён сравнительный анализ методов и средств измерения солёности. Рассмотрена разработка индуктивного датчика солености, входящего в состав исследовательского зонда, располагающегося на беспилотном надводном аппарате, проводящем мониторинг водной поверхности и локализирующем загрязнения. Создана структурная схема устройства. Разработанное устройство имеет низкое энергопотребление и высокую точность измерения, благодаря использованию микроконтроллера и автоматической подстройке диапазона измерения проводимости водной среды.

Ключевые слова: солёность, датчик, индуктивный метод, проводимость, измерение.

Annotation. The article considers the problem of measuring the salinity of surface waters, analyzes the causes of changes in salinity, as one of the key parameters indicating changes in the composition of water. A comparative analysis of methods and means of measuring salinity is carried out. The development of an inductive salinity sensor, which is part of a research probe located on an unmanned surface vehicle that monitors the water surface and localizes pollution, is considered. The constructed device has a low power consumption and high measurement accuracy, thanks to the use of a microcontroller and automatic adjustment of the measurement range of the medium conductivity.

Keywords: salinity, sensor, inductive method, conductivity, measurement.

UDC 621.3
NEW USER'S SOFTWARE FOR TEMPERATURE SENSORS

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Introduction

Quit all of the typical technical equipment applications meet the usual difficulties like a necessity in specialized software adopted to a place of installation by professional programmers. A problem increases itself in a case to determine a measurement order of sensors according the final user request and real automation. This way is enough expensive and significantly exceeds for sure a sensors price even they are absolutely not cheap.

New approach

At a moment is realizing the new idea of user's software creating, which is useful for a wide task circle, including a chain from preliminary sensors installation to the automatic searching and disorder liquidation of the new temperature sensors during exploitation, during simultaneous execution of the main function of reading control of measuring and service information, of it dynamic visualization in the displayed table protocol and also transmitting to necessary addresses into devices of registration, automatics and the decisions generators. A connection to the installed temperature sensors on the digit level is realizing with one non-expensive communicative cable without distortions or noise to a distance up to 5 km by means of two RS485 wires plus electro supply +2.. 5V.

The new software is aimed for automatic information reading by protocol mod-bus with defining order of reading of sensors massive up to 200 also with automatic diagnostics, localization and malfunction elimination. Program Ferrum-plus is oriented for maximum of automation and for serious hand labor decrease.

Enumerated tasks are solving for a first time. The new possibilities for customers give a significant progress in sensor automation. Notice the universality of approach. It allows creating the base for any sensors, not only of temperature. Another feature of a realizing approach is simple and friendly software, which don't require a special preparation and a wide knowledge in programming mastering. In deal a user's software is a universal work piece of modified program by user, made by professionals, with a help of which a user easily and exactly solves his necessary tasks.

A protocol visualization form of working results of program is represented in the Control Table (see Table 1). A program periodically scans all accessible address space of sensors, provides an identification of all nodes, including with plant number, class of accuracy and a network address. Also program provides monitoring of each sensor. It ensures

control an exceeding of working measurement range limits, contact absence or shot-cut of primary sensor, work errors, data stability. Program sets an optimal transmitting speed of information from a standard range up to 9,6 kBod.

Table 1. A protocol visualization form

status of a communicative network, automatically				
the sum of a cycle duration of the sensors reading XX,XXX sec sum of the 4-th column, automatically				
sensors at all/normal/emergency, automatically				
a reading number in a cycle	**sensors number, accuracy class, network address**	**user descripton, sensor status**	**reading dura-tion** with sensor digital filter, mS	**register mod-bus, result, including temperature, address for delivery**
1 *settles*	*defines by program*	*status defines by program*	*defines by program*	*register type and address settle by user*
2				
3				
.. to 200				

With a base of received data program automatically defines the status of interface network and of each sensor, normal-emergency. At localization emergent statement of sensor or sensors group program provides their deleting from the list of normal. A sensors dubbing is available.

In a case on importance of the exact order of sensors reading, a reading number in the cycle is set by user in the 1-st column of driving table. The new soft is friendly in usage and installation.

The significant conclusions

1. On reality the free user's software is greatly useful; because it increases an efficacy of user job at some stages of work many times. Sometimes it allows passing difficulties without professional programmers at all.

2. A major difference of a new product is only one universal position for all users of sensors instead of became "traditional" and archaic approach of usual creation of non-counting quantity of specialized expensive programs for each place of their application.

Reference:

1. Industrial temperature sensor Ferrum: presentation, site webgas.ru of enterprise Iron Sunrise, 2021. 16 p.

Аннотация. Новая идея создания пользовательского программного обеспечения, полезного для широкого круга задач,

включая цепочку от предварительной установки датчиков до автоматического поиска и устранения неисправностей новых датчиков температуры в процессе эксплуатации, при одновременном выполнении основной функции считывания контроля измерения и служебная информация, ее динамическая визуализация в протоколе отображаемой таблицы, а также передача в устройства регистрации, автоматики и генераторы решений по необходимым адресам.

Перечисленные задачи решаются впервые. Новые возможности для клиентов дают значительный прогресс в автоматизации датчиков. Отмечена универсальность подхода. Это позволяет интегрировать базу для любых датчиков, а не только температуры.

Еще одна особенность реализационного подхода – простое и понятное программное обеспечение, не требующее специальной подготовки и обширных знаний в области программирования. При этом программное обеспечение пользователя – это универсальная программа, модифицированная пользователем, созданная профессионалами, с помощью которой пользователь точно решает поставленные задачи.

Ключевые слова: датчики, программное обеспечение, эффективность пользователя, предприятие Iron Sunrise, сайт webgas.ru.

Annotation. The new idea of user's software creating, which is useful for a wide task circle, including a chain from preliminary sensors installation to the automatic searching and disorder liquidation of the new temperature sensors during exploitation, during simultaneous execution of the main function of reading control of measuring and service information, of it dynamic visualization in the displayed table protocol and also transmitting to necessary addresses into devices of registration, automatics and the decisions generators.

Enumerated tasks are solving for a first time. The new possibilities for customers give a significant progress in sensor automation. The universality of approach is noted. It allows integrating the base for any sensors, not only of temperature.

Another feature of a realizing approach is simple and friendly software, which don't require a special preparation and a wide knowledge in programming mastering. In deal a user's software is a universal work piece of modified program by user, made by professionals, with a help of which a user easily and exactly solves the necessary tasks.

Keywords: sensors, software, user efficacy, enterprise Iron Sunrise, site webgas.ru.

THE NEW INDUSTRIAL TEMPERATURE SENSOR

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Introduction

Temperature sensors are necessary for accurate temperature measurement, they can be used in greenhouses, homes, in the food industry, chemical industry, in mechanical engineering, in oil and gas production, on ships, in aviation, space and in other industries where temperature measurement is required.

It is necessary to increase accuracy, stability and a solid service life in difficult operating conditions.

Problem resolving

The technical decisions indicated below concern to the not bed new temperature sensor Ferrum, which 32 variants provide the measuring part length from 10 till 1500 mm, in-built in the cable plug 2-wire digital interface RS485, any working orientation; for an application with liquid, gas, steam, particulate substances and solid bodies; measuring range - 60.. +200°C, environment -60.. +85°C; with 50 years of service life.

For this purpose, it was developed the constructive solution of new industrial sensors Ferrum made them very attractive according the all complete set of 40-ty characteristics [1] with the catastrophic advantage from two times up to dozens of thousands. During the provided investigations it was found, that accuracy, stability and respectable service age are impossible at the insufficient equitability of the heat field inside of a sensor.

The fragment of temperature equitability at a stage of a construction design is shown in Fig.1.

There are fifty of controlled temperature values on the surface of 2 mm platinum primary sensor. In a combination with studying the new sensors characteristics and of their limit possibilities in a field of instrumental measuring

noise, accuracy and durability. The hundreds of models were suggested, processed and studied. Gradient of 10°C in the wrongly designed sensor is a usual circumstance. The best solution among those hundreds models was selected with criteria of the mentioned minimum temperature gradient.
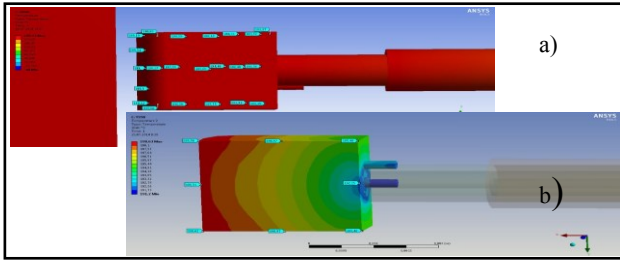
Figure 1 – The fragment of temperature equitability at a stage of a construction design

a)   The surface of the designed temperature sensors of 2 mm primary platinum sensor was divided by 50 local areas with the controlled temperature, a criteria of research – the minimum temperature gradient in the condition of influence external temperature -60.. +85°C, type of measuring matter (liquid, gas, steam or other) and it physical parameters, as velocity, density, viscosity in a temperature range -60.. +200°C,
b) Over than 90% of energy from an environment comes to sensor by a cable.

The test of the optimized sensor was implemented. The noise of sensor of class ± 0,03°C without digital filter is shown in Fig 2 (red color).

The filter gives a supplementary 3-time decreasing of measuring result of shot time fluctuation; the limits of a shot-time non-stability according technical conditions is ± 0,001°C. It became possible to refuse from consideration of so called an additional measuring error of real service conditions influence, like an ambient temperature, humidity, the parameters of measuring subtract movement.

Figure 2 – Shot-time temperature measurement non-stability in the melting ice among the sensors of metrological class ±0,03°C

It increases an accuracy of measurement additionally in 2-3 times and makes our sensors significantly competitive.

Conclusion

The Ferrum sensors are the subject of interest from everywhere, where the temperature at all is utilizing.

Reference:

1. Industrial temperature sensor Ferrum: presentation, site webgas.ru from enterprise Iron Sunrise, 2021. 16 p.

Аннотация. Новый промышленный датчик температуры Ferrum (32 варианта) обеспечивает длину измерительной части от 10 до 1500 мм, цифровой интерфейс RS485 в кабельной вилке, любую рабочую ориентацию датчиков; для всех типов измерительных сред: жидкости, газа, пара, твердых частиц и твердых тел; диапазон измерения -60 .. + 200 ° C, окружающая среда -60 .. + 85 ° C; срок службы до 50 лет.

Отмечено, что конструктивное решение новых промышленных датчиков Ferrum сделало их лучшими в мире одновременно по всей комплектации из 40 характеристик с катастрофическим преимуществом от двух раз до десятков тысяч. Выяснилось, что точность, стабильность и приличный срок службы невозможны при недостаточной равномерности теплового поля внутри датчика. Поэтому автор предложил провести оптимизацию месторождения еще на этапе строительства объекта.

Ключевые слова: датчики температуры, оптимизация распределения теплового поля, точность, стабильность, срок службы, предприятие Iron Sunrise, сайт webgas.ru.

Annotation. The new industrial temperature sensor Ferrum, 32 variants provide the length measuring part from 10 up to 1500 mm, digital interface RS485 in the cable plug, any working orientation of sensors; for all types of measuring environments: liquid, gas, steam, particulate substances and solid bodies; measuring range -60.. +200°C, environment -60.. +85°C; service life till 50 years.

The constructive solution of new industrial sensors Ferrum made them very attractive according the all complete set of 40-ty characteristics with the catastrophic advantage from two times up to dozens of thousands. It was found, that accuracy, stability and respectable service age are impossible at the insufficient equitability of the heat field inside of a sensor. That is why the author suggested a field optimization at the stage of the project construction.

Keywords: temperature sensors, heat field distribution optimization, accuracy, stability, service time, Iron Sunrise enterprise, site webgas.ru.

SECTION 2: INFORMATION SYSTEMS AND TECHNOLOGIES

UDC 621.331

MODELING ELECTROMAGNETIC STRUCTURES OF A HIGH-POWER WIRELESS TRANSMISSION SYSTEM IN THE PRESENCE OF COMPLEX SHIFTS

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The relevance of wireless power transmission systems is becoming more visible every day. This is due to the popularity of autonomous devices that have rechargeable batteries in their configuration. It is difficult to imagine our life without a phone or a car. All devices with a rechargeable battery are subject to the need to recharge in one way or another. This aspect makes the process of studying such systems even more relevant.

Today, wire or contact methods for recharging batteries of various kinds of devices are actively used. This technique has several advantages. First of all, this is the almost complete absence of losses in the process of energy transfer from the transmitter to the receiver. However, the disadvantages of this kind of systems are known and cause significant inconvenience in the process of their operation. Among such disadvantages is the presence of contacts that can harm living organisms, and are also easily deformable, which makes the system of recharging batteries unusable in whole or in part. Among the existing wireless power transmission systems, the Chinese standard "qi" is relevant, which is ubiquitous in the form of systems for wireless recharging of batteries, but this technology has a number of disadvantages. First of all, this is a limitation on power characteristics. This technology uses the inductive method of transferring electrical energy, and the disadvantages of this method are the strong dependence of the transfer coefficient on the distance between the structures. Losses at a distance of 10 mm between structures are about 90%, which introduces significant restrictions on the application of this technology.

Earlier in the article [1], a method of wireless energy transmission was presented, in which microstrip lines were used as electromagnetic structures. This technology has shown satisfactory results in the efficiency of electric power transmission. Within the framework of this work, a model of electromagnetic structures was developed, shown in Figure 1.
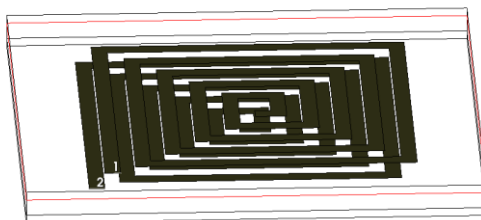
Pic 1 – General view of microstrip lines in the MWO environment

Electromagnetic structures are two microstrip lines twisted into a spiral. The material of the lines is copper, the electrical parameters of the air medium are set as the dielectric between the structures, and polycarbonate is used as the dielectric substrate. The length of the line is about 2200 mm, the width of the lines is 10 mm, the gap - the distance between the turns corresponds to 10 mm.

The article [2] also presented studies of the proposed structure in the MVO environment in the presence of shifts along the x and y axes, however, in practice, shifts can be complex, which requires additional research. The study of the electromagnetic structure in the presence of a complex shift along all axes is relevant. ThisshiftisshowninFigure 2.
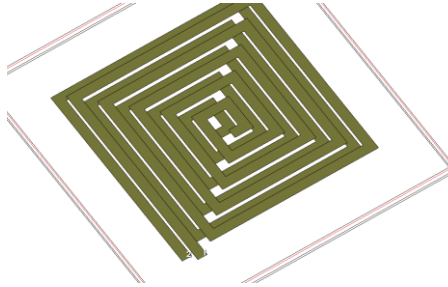
Pic. 2 – Configuration of shifts of microstrip lines in an MWO environment

To model the structure, it was decided to use the value of the distance between the structures equal to 10 millimeters, since this distance is optimal from the point of view of the efficiency of the energy transfer process. With this, an offset of 10 millimeters was added. The result of modeling the presented configuration of the structure is shown in Figure 3.
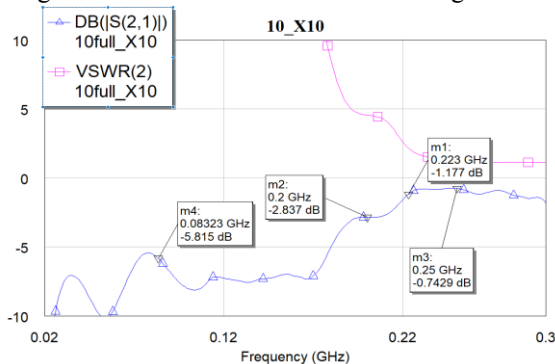
Pic. 3 –The result of system modeling in the MWO environment

For a complete understanding of the effect of various kinds of shifts on the efficiency of the electric energy transfer process, in this configuration, radial shifts by 45 degrees were also added. This configuration is shown in Figure 4
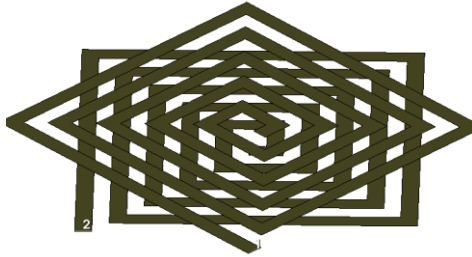
Pic. 4 – Configuration of complex shifts of microstrip lines in an MWO environment

The simulation result of the presented configuration is shown in Figure 5.
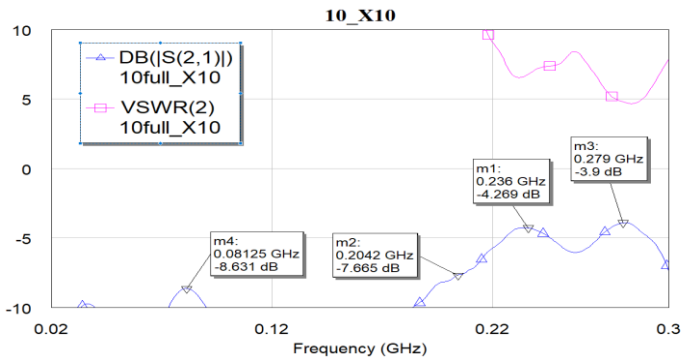
Pic. 5 – The result of system modeling in the presence of complex shifts in the MWO environment

Based on the studies carried out, it can be concluded that the effect of radial shifts of electromagnetic structures on the process of wireless transmission of electrical energy is significant relative to offset shifts. The research was carried out in the MWO environment. It is assumed that the use of a round spiral shape can significantly change the value of losses in the process of wireless transmission of electrical energy.

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Shirokov // Proceedings of the 2020 IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering, EIConRus 2020, St. Petersburg and Moscow, 27–30 января 2020 года. – St. Petersburg and Moscow: Institute of Electrical and Electronics Engineers Inc., 2020. – P. 1306-1310.

Аннотация. В статье представлен результат компьютерного моделирования системы беспроводной передачи энергии в среде MBO при наличии комплексных радиальных и офсетных сдвигов. Исследования проводились на расстоянии между структурами 10 мм. Параметры структур брались в соответствии с мощностью, необходимой для передачи энергии.

Ключевые слова: система беспроводной передачи энергии, подзарядка, моделирование, электромагнитная структура, микрополосковая линия.

Annotation. The article presents the result of computer modeling of a wireless power transmission system in an MVO environment in the presence of complex radial and offset shifts. The studies were carried out at a distance of 10 mm between the structures. The parameters of the structures were taken in accordance with the power required for energy transmission.

Keywords: wireless power transmission system, charging, modelling, electromagnetic structure, microstrip line.

UDC 004.021,004.031,004.032,004.62

FEATURES OF RECOMMENDATION SYSTEM ARCHITECTURES FOR NEWS CONTENT

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Relevance. With the rapid development of the Internet, more and more people have received information from various online news portals. Viewing news content online has become a popular way to get information around the world.

Content is information from any medium (paper, electronic) or Internet resource, expressed in various forms. Content can be classified by the method of transmission, by the sites for placement, by the method of touch, by the formats and by the source of the content.

News content includes text, photos, and videos that contain up-to-date information about current events and phenomena. In addition, an important characteristic of this content is a relatively short period of relevance.

With a huge number of available news portals, the user has access to a large flow of information that is not always of interest to him. The abundance of information creates a lack of attention and the constant need to choose how to effectively distribute the attention of users among the excessive amount of daily information. The system of recommendations was created to solve various tasks and provide users with the information that corresponds to their interests, i.e. the system helps when searching the Internet for more relevant information for the user.

Recommendation systems have opened up a new way for the user to interact with websites and have become widespread for businesses in recent years.

News recommendation systems present articles to individual users based on their interests, rather than presenting articles in the order they appear. Recommendations of news stories to users based on their preferences have long been a favorite area of research for recommendation systems. Media systems strive to satisfy their users by tracking their reading history and selecting suitable news articles-candidates for recommendation. Recommendation news systems are one of the approaches that help users find interesting articles to view.

With a large number of news articles, a very important issue for online news services is how to help users get interesting news that best matches their preferences, which is the problem of personalized news recommendations. The initially collected data is of great importance, since the quality of the received information depends on the quality of the further model.

The purpose of this work is to analyze the methods of recommendation systems for news content to identify the shortcomings of algorithms for generating news recommendations, as well as to identify effective ways to introduce the user to new content that may interest the user and encourage the consumption of more content.

Analysis of existing solutions. One of the earliest recommendation systems is Tapestry, which filters email using collaborative filtering. A significant number of studies have been conducted to provide personalized recommendations to users in many different fields, such as news, movies, television, books, products, activities, music, tourism, etc. These recommendation systems can generally be divided into two types: content filtering (CBF) and collaborative filtering (CF). Content filtering generates a user profile from the user history and compares it with new elements to

generate recommendations. Collaborative filtering generates recommendations by analyzing the stories and ratings of community users. However, the main disadvantage of both methods is the problem of cold start, when they may not be able to give appropriate recommendations to new users or evaluate new products. To overcome this problem, several studies have suggested combining several techniques to form a hybrid recommendation system. In addition to the problems of cold start, this type of system has a problem of low responsiveness to the short-term preferences of the user. However, these systems are mainly designed for traditional web recommendations and do not use contextual information from users [2].

Contextual information provides an important basis for understanding the information needs of users. With the development of technology and devices, recommendation systems can incorporate users' surrounding contextual information (such as user actions, preferences, actions, location, weather, time, with whom, etc.) to provide users with more relevant recommendations.

There are a number of context-sensitive recommendation systems. They use contextual attributes and combine implicit / explicit user preferences when making recommendations. However, such approaches increase the amount of data used in calculations.

In addition to the above methods, there are recommendation systems based on a peer-to-peer (P2P) architecture, taking advantage of distributed systems. A number of P2P-based recommendation systems have been proposed. These include various mobile services based on a context-sensitive system in a hybrid P2P network. These services support communication between clients in addition to communication between clients and servers for information exchange. A mobile user can subscribe to the weather service for real-time weather information, or subscribe to nearby user nodes for user comments.

Client-server-based approaches suffer from a single point of failure and have limited scalability, while P2P-based approaches can overload the network and be less efficient. However, despite the disadvantages, this type of recommendation systems has a high response to new content.

Along with the peer-to-peer architecture, there are proactive recommendation systems. This type of system automatically profiles and filters users. The real-time recommendation module needs to sense the user's environment, context, and autonomously predict the user's needs and deliver relevant content at the right time. This type of software includes the JHPeer framework, which is designed to build context-sensitive recommendation systems.

Currently, recommendation systems using various neural network models are actively developing. One of the modern representatives of this direction is graph neural models of news recommendations. An example is the GNewsRec recommendation system with modeling of long-term and short-term interests [1]. The method is based on graph convolutional networks to predict the long-term interests of the user. The user's short-term interest is also modeled using the user's recent reading history using an attention-based LSTM model.

Comparative analysis of existing solutions. The comparative analysis of the solutions was carried out on the basis of eight criteria, which affect both the assessment of the system's response rate to environmental changes and the assessment of the load on computing devices. The result of the comparison is shown in Table 1.

Table 1 – Comparative analysis of existing solutions

Types of recommendation system algorithms / Parameters	CBF and CF	Context-sensitive	P2P	Proactive	Systems with neural networks
Reaction to changes in the user's short-term preferences	1	2	2	1	1
Reaction to changes in the user's long-term preferences	2	1	0	1	1
High speed of recommendations	1	1	2	2	2
High reaction to new news content	0	0	1	2	1
Solving the cold start problem	0	2	2	0	0
Working with a small amount of data	1	2	1	2	1
Low load on server hardware	1	2	1	0	1
Low load on client hardware	2	1	1	2	2

The results were obtained by expert evaluation of various scientific papers, as well as by analyzing the functioning of existing recommendation systems. As can be seen from Table 1, context-sensitive recommendation systems are the most preferred. It is worth noting that it is necessary to check other criteria aimed at assessing the quality of recommendations, which will be done in the future.

Conclusion. Modern recommendation systems have a high quality of recommendations, however, improving the quality of recommendations is associated with the complexity of the algorithms of the recommendation system and the amount of information processed. Analyzing the evolution of methods for building recommendation systems for news content, we can conclude that the main direction of development affects data processing algorithms on the server side, which increases the load on the system with the increasing complexity of the algorithms and the growth of the client base. This problem leads to a reduced response to new content, which is unacceptable due to its short news life. In addition, it is necessary to resort to reducing the quality of recommendations by artificially reducing the possible variants of recommendations involved in data processing. With this in mind, in order to increase the responsiveness of hybrid recommendation systems, we propose adding modules for generating recommendations on the side of client machines, which allows to have the highest response to changes in the user context, as well as developing architectures that support continuous communication between clients in addition to communication between clients and servers for information exchange, which allows to increase the response to fresh news content that may be of interest to users with similar preferences. In this way, you can achieve the formation of recommendations based on both long-term and short-term user preferences.

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Аннотация. В работе анализируются методы рекомендательных систем новостного контента для выявления недостатков алгоритмов выработки рекомендаций новостей, а также определения эффективных способов ознакомления пользователя с новым контентом, который может заинтересовать пользователя и побудить к потреблению большего объёма контента. Сравнительный анализ решений

производился на основе восьми критериев, которые затрагивают как оценку скорости реакции системы на изменение окружающей среды, так и оценку нагрузки на вычислительные устройства. Результаты были получены путем экспертной оценки различных научных работ, а также анализа функционирования существующих рекомендательных систем.

Ключевые слова: гибридные рекомендательные системы, веб-технологии, новостной контент.

Annotation. The paper analyzes the methods of recommendation systems for news content to identify the shortcomings of algorithms for making news recommendations, as well as to determine effective ways to familiarize the user with new content that may interest the user and encourage the consumption of more content. The comparative analysis of the solutions was carried out on the basis of eight criteria, which affect both the assessment of the system's response rate to environmental changes, and the assessment of the load on computing devices. The results were obtained by expert evaluation of various scientific papers, as well as by analyzing the functioning of existing recommendation systems.

Keywords: hybrid recommendation systems, web technologies, news content.

UDC 681.3

CONTROL AND COMMUNICATION ORGANIZATION DURING THE PROCESS OF THE ELIMINATION OF EMERGENCY SITUATION

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Introduction. The unified basis of the communication system of the EMERCOM of Russia is a complex of interconnected stationary and mobile communication centers of the control points of the EMERCOM of Russia, as well as channels and communication lines of the EMERCOM of Russia and the unified telecommunication network of the Russian Federation, which are responsible for the exchange of various types of information.

The communication system of the EMERCOM of Russia is based on a radial-node principle. The stationary communication system operates in a

permanent mode and includes communication centers or points of communication of central subordination, territorial bodies of the EMERCOM of Russia, control points of rescue military formations and institutions of the EMERCOM of Russia, emergency rescue teams, subdivisions and communication services of the federal fire service, state inspection for small boats and a paramilitary mountain rescue unit.

The mobile part consists of mobile communication centers of the control centers in crisis situations of the EMERCOM of Russia at the federal and interregional levels, mobile communication facilities of the main directorates of the EMERCOM of Russia for the constituent entities of the Russian Federation, communication units of rescue military formations, institutions of the EMERCOM of Russia, the Federal Fire Service, communication services of rescue teams [1].

The main part. Satellite and radio communications are used to create a reserve of wire communication channels in the main information areas and, together with wire communication, are the main type of communication in emergency areas.

Currently, the basis of the wire communication network of the EMERCOM of Russia is a complex of interconnected stationary communication centers of the EMERCOM of Russia control points and wire communication lines. Wired communication is based on a radial-nodal principle, similar to the hierarchy of control points of the EMERCOM of Russia. Analog and digital communication channels leased from operators can be used. The transmission of channels from communication centers of communication operators to communication centers of the Ministry of Emergency Situations of Russia is organized along the lines:

– analog channels over physical lines and analog transmission systems operating over copper cable and radio relay communication lines;

– transmission of digital channels operating over copper cable communication lines, fiber-optic communication lines, digital radio relay communication lines and satellite communication channels.

Analog communication channels are used for audio conferencing, telephone and telegraph communications operation. The equipment for the analogue communication channels is currently not produced. Repairs are made on the basis of restoring one kit from several others. The share of analog channels in the communication system of the Ministry of Emergency Situations of Russia is constantly decreasing as the unified telecommunication network of the Russian Federation switches to digital technologies. Digital communication channels are used at different stages of the EMERCOM of Russia management to create and maintain the departmental telephone network, "Intranet" data transmission network,

video surveillance, video conferencing and access to information resources. The total number of digital communication channels is increasing every year, at the same time; the requirements for improving the bandwidth are increasing All this steps provide the creation of an automated operational management system of the EMERCOM of Russia [2].

The main tasks in the field of radio communication of the EMERCOM of Russia are:

– communicating warning signals, combat control and orders to control bodies;

– ensuring the exchange of information between the control points of the EMERCOM of Russia and with interacting federal executive bodies;

– providing communication with operational groups working in emergency areas;

– providing communication with convoys;

– providing communication with remote search and rescue formations, fire garrisons, units of the paramilitary mountain rescue unit and in places where there is no communication infrastructure;

– providing communication with air, sea and river vessels;

– functioning of communication directions in case of failure of wired, radio relay channels and communication lines;

– providing communication with those divisions for which the only type of communication is radio communication;

– increasing the throughput of information lines.

Short-wave radio communication in the EMERCOM of Russia is one of the main types of communication with operational groups from emergency areas.

In daily activities, radio communication creates a reservation of wired communication channels for the main information areas. The HF radio communication system of the EMERCOM of Russia is the composition of the HF radio communication equipment, which are deployed at stationary and mobile control points. They provide open or secret telephone and telegraph communication in radio networks and radio directions of various control links. In addition, they have the ability to transmit data over secret communications on radio lines and over 3000 km.

In the governing bodies and subdivisions of the EMERCOM of Russia, performing tasks within the framework of the Unified State System for the Prevention and Response of Emergency Situations, HF - packet radio communication is widely used [3]. The main tasks of creating a packet HF radio communication EMERCOM of Russia are as follows:

– creation of a unified information network of the EMERCOM of Russia, which ensures the operational group of fire and rescue teams of the

EMERCOM of Russia, as well as the Main Directorates of the EMERCOM of Russia for the constituent entities of the Russian Federation from the areas of emergency situations;

– ensuring the automated passage of various types of information between users and control points as soon as possible (data and fax transmission at a speed of up to 6000 bps, access to an automated telephone exchange, e-mail);

– exit of the operational group of the EMERCOM of Russia from the emergency area to the departmental digital telephone network and the public telephone network;

– increasing the reliability of communication due to the optimal use of antennas to overlap the transmission zones of HF radio waves;

– pair selective call of subscribers.

HF radio communication provides equipment of mobile communication centers, search and rescue teams and operational groups of the Main Directorates of the Ministry of Emergency Situations in the constituent entities of the Russian Federation. There are limitations in the use of HF radio communications - the low staffing of the main departments of the EMERCOM of Russia in the constituent entities of the Russian Federation with stationary, automobile and portable radio stations, as well as the availability of switching facilities for digital communication networks with the integration of services only at the interregional level.

At all stages of operation of the EMERCOM of Russia, VHF radio communication is used, which is the main type of communication in the elimination of fires and other emergencies, as well as during drillings. The joint order of the Ministry of Emergency Situations and the Ministry of Internal Affairs of Russia provides for the transfer of the radio networks of the FBS EMERCOM of Russia to a new frequency range, which requires replacement of radio communication equipment. For this, radio networks must be deployed on the old and new frequencies. Radio networks on old frequencies can only be taken out of action after opening radio networks on new frequencies.

Conclusion. Information exchange in the EMERCOM of Russia is provided through the use of the Internet, as well as through the channels of the internal network. Information portals of departments and offices of the central office, as well as of all Main Directorates of the Ministry of Emergency Situations in the constituent entities of the Russian Federation are organized in the Intranet network. Each user registered in the network of the Ministry has the opportunity to receive and transmit electronic messages: text, graphic, etc. The same opportunities are provided for users and operational services of regional centers. The Internet network provides

work with the population and organizations of various departments, as well as access to national information resources and e-mail services of structural units of the EMERCOM of Russia. The number of automated workstations connected to the Internet in the EMERCOM of Russia is increasing every year, and an automated system for advising and servicing the population and organizations on safety in emergency situations is functioning.

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Аннотация. Статья посвящена рассмотрению вопросов организации управления и связи при ликвидации чрезвычайных ситуаций. Раскрыты роль, функции и основные задачи радиосвязи МЧС России. Представлена структура и перспективы информационного обмена в МЧС России.

Ключеные слова: МЧС, организация управления, связь, чрезвычайная ситуация.

Annotation. The article considers the issues of management and communication organization in the context of emergency situations elimination. The role, functions and main tasks of radio communication of the Ministry of Emergency Situations of Russia are stated. The structure and prospects of information exchange in the EMERCOM of Russia are presented.

Keywords: Ministry of Emergency Situations, management organization, communications, emergency.

CALCULATION OF THE PARAMETERS CIRCUITS OF HIGH-FREQUENCY CORRECTION PROVIDING THE OBTAINING OF THE MAXIMUM FLAT AFC

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Broadband amplifiers with a bandwidth of 100–1000 MHz and higher are used in communications technology in the making of multichannel systems, in modern computing devices, in radars station, television, in measuring equipment, etc. However, the simplest amplifier circuits usually cannot provide uniform gain in this frequency region.

For broadband amplification, usually resistor amplifier is used, which have good frequency and temporal characteristics, into which special correction circuits are introduced. The most efficient bandwidth expansion can be achieved using an inductive the high-frequency (HF) correction circuit.

In the literature [1, 2], the issues of the influence of correction circuits in wideband amplifiers on the time and frequency characteristics of the cascade are considered, however, the issues of choosing the parameters of the correcting elements to obtain the frequency characteristics with a maximum flat AFG are not considered fully. The aim of this work is to analyze a cascade with inductive HF correction and to find relationships for calculating the parameters of correction elements that provide receiving the maximum flat AFC of the cascade.

The scheme of the cascade with inductive HF correction is shown in fig. 1. Correction is carried out using a coil L of small inductance, connected in series with resistance R_c.

A simplified equivalent circuit of a cascade with inductive HF correction is shown in fig. 2.
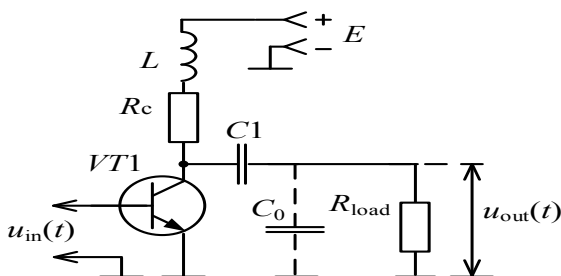
Figure 1 – The scheme of the cascade with inductive high-frequency correction
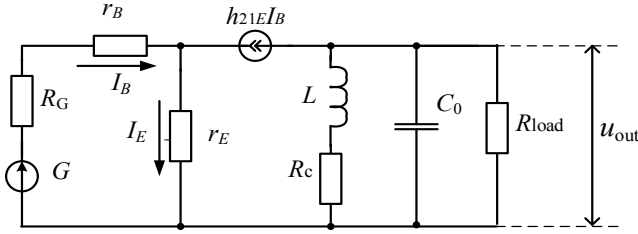
Figure 2 – Simplified equivalent circuit of a cascade with inductive HF correction in the high frequency region

Inductive high-frequency correction works effectively if the load resistance significantly exceeds the resistance of the resistor in the collector circuit, that is, the ratio $Rout \gg Rc$ [1] is fulfilled. The equivalent circuit also shows the parasitic capacitance of the stage (C_0), which affects the AFC in the high-frequency region. It can be seen from the equivalent circuit that the load of the cascade, taking into account $Rout \gg Rc$, is a parallel resonant circuit formed by the LR_cC_0 elements.

As a result of the analysis, an expression was obtained for calculating the modulus of the normalized coefficient gain of the cascade in the high frequency region.

$$\left| \frac{K(j\omega)}{K_0} \right| = \sqrt{\frac{1+m^2\omega^2\tau^2}{1+\omega^2\tau^2-2m\tau^2\omega^2+m^2\tau^4\omega^4}} \, , \tag{1}$$

where K_0 — coefficient gain in the mid-frequency region; $m = \dfrac{L}{R_c^2 C_0}$ — the coefficient of correction; L — correction inductance; $\tau = R_cC_0$ — time constant of the output circuit; C_0 — cascade output circuit capacity.

To obtain the maximum flat AFC of the device, it is necessary to ensure equality of the coefficients at the same even powers of ω for the polynomials in the numerator and denominator of the expression for the modulus of the transfer coefficient.

In our case, it can be seen from (1) that it is necessary to equate the coefficients only for ω^2

$$m^2\tau^2 = \tau^2(1 - 2m)_.$$

From here we obtain the equation of the second degree for calculating the coefficient of correction m.

$$m^2 + 2m - 1 = 0_. \tag{2}$$

Solving equation (2), we find

$$m_{1,2} = -1 \pm \sqrt{2}_.$$

Taking into account that m must be a positive number, we get
$$m = 0{,}414.$$
Hence it follows that to obtain the maximum flat AFC, the correcting inductance L can be calculated from the relation

$$L = 0{,}414 R_\mathrm{c}^2 C_0 \ . \tag{3}$$

In fig. 3 shows the graphs of the frequency response of the cascade at various values of the correction coefficient m. At m = 0.414, we get the maximum flat frequency response. At m > 0.414, an increase in the gain is observed at high frequencies.

Calculations have shown that the maximum win gain obtained in the area of amplification when using a correcting inductance calculated by formula (3) (m = 0,414) is 1,72. That is, the bandwidth of the amplifier with the correct selection of the correcting inductance can be increased by almost 2 times.

The maximum in the AFC, formed at m > 0,414, can be used to reduce frequency distortions arising in other stages of a multistage amplifier, that is, to perform mutual correction.
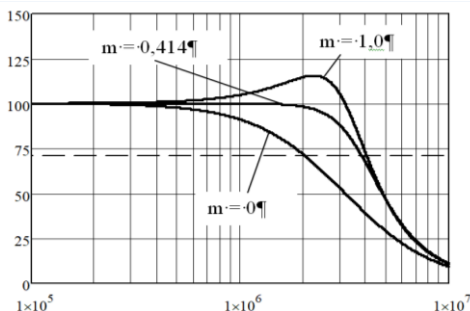
Figure 3 – AFC of the cascade at different values of
the correction coefficient

Thus, the analysis of the cascade with inductive high-frequency correction in the high-frequency region is carried out and an expression is obtained for calculating the correcting inductance, which makes it possible to obtain the maximum flat AFC in the cascade. The gain in gain area obtained in this case is 1,72.

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Аннотация. Проведен анализ схемы индуктивной высокочастотной коррекции в области высоких частот. Построена эквивалентная схема каскада в области высоких частот. Найдено выражение для комплексного коэффициента усиления каскада. Получено выражение для расчета корректирующей индуктивности, позволяющей получить в каскаде максимально плоскую АЧХ. Расчеты показали, выигрыш по площади усиления в этом случае составляет 1,72. Построены АЧХ каскада при различных значениях коэффициента коррекции. Показано, что максимум в АЧХ, образующийся при $m > 0,414$, может быть использован для осуществлении взаимной коррекции многокаскадного усилителя.

Ключевые слова: широкополосные усилители, индуктивная коррекция, максимально плоская АЧХ, площадь усиления.

Annotation. The analysis of the circuit of inductive high-frequency correction in the high-frequency region is carried out. An equivalent circuit of the cascade in the high-frequency region is found. An expression for the complex coefficient gain of the cascade is obtained. An expression is gotten for calculating the correcting inductance, which makes it possible to obtain the maximum flat AFC in the cascade. Calculations have shown that the gain in the area of amplification in this case is 1,72. The AFC of the cascade is plotted for different values of the correction factor. It is shown that the maximum in the AFC, which is formed at m > 0,414, can be used for mutual correction of a multistage amplifier.

Keywords: broadband amplifiers, inductive correction, maximally flat frequency response, gain area.

PROBLEMS OF THE INTERNET OF THINGS
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Introduction

The Internet of Things is already indispensable in many areas of business, optimizing time and costs. But the trend is only at the very beginning of its path, and the IoT concept itself is constantly being improved. The price of sensors is reduced by increasing the volume of their production and reducing the cost of components. The size decreases — the devices become more and more miniature.

The term "Internet of Things" (Internet of Things, IoT) was first used in 1999, when an employee of Procter & Gamble's Kevin Ashton suggested using radio–frequency identification (RFID) tags to optimize the corporation's logistics.

The growth of the number of Internet-connected devices and software systems, the expansion of the range of their use in industrial production, as well as inter-industry interaction can be considered as a key challenge of our time. Despite the fact that the first mention of the "Internet of things" appeared more than 20 years ago, the active development of technologies has been noted only in recent years. The relevance of this direction is constantly growing [2].

The main part

The "Internet of Things" is a computer network of physical objects equipped with built-in technologies for collecting and transmitting information in conjunction with devices and technologies for storing and intelligent information processing, as well as devices and algorithms for generating control actions, both parts of the system and on global ones.

The Internet of Things technology combines various devices into a single computer network, allowing them to collect and analyze data, as well as transmit it to other devices using applications, software and technical devices. Devices can work without human intervention, but users can interact with them: give instructions, configure and provide access to data. As a rule, such systems operate in real time. The introduction and widespread development of the Internet of Things was made possible by the widespread use of mobile gadgets [1].

The emergence of Internet of Things technologies has given rise to structural changes in the economy. Today, the Internet of Things is used not only for industrial production, but also in other industries. For example, these technologies are widely used in healthcare.

The idea of the Internet of Things has its own weaknesses and vulnerabilities. They are already trying to work on their solution, but the current level of technology does not allow us to solve everything at once.

- Dependence of the system elements on each other. Failure or failure of one element will cause a chain reaction, which is why the Internet

of Things will solve the tasks in non-trivial ways, provoke the failure of other devices or simply turn off. For example, on "smart" thermometer, the temperature sensor will fail – and the "smart" wardrobe, based on its readings, will advise the owner of clothes not for the weather [1].

- Fear of hacker attacks. Everything that exists at the moment in the environment of "smart" devices has its own vulnerabilities, knowing which, you can get access to the system and important information about the user.

- Total dependence of the system on energy resources. Even if humanity switches to virtually inexhaustible resources in the form of alternative energy sources (sunlight, geothermal thermal power plants, etc.), to completely disable the system in a certain area, it will simply be necessary to disable the energy source. For this reason, this development is unlikely to be used for military purposes, leaving the war to people: a controlled electromagnetic field, available now, burns any electronics, no matter how "smart" it may be.

- Possible degradation of humanity due to the critical simplification of life.

Conclusion

Many people do not take into account some of these vulnerabilities, but do not forget that until the recent past, the Internet of Things itself was impossible. With the level of technology growth, the boundaries of opportunities also change – and this should not be forgotten.

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Аннотация. С появлением интернета вещей жизнь каждого человека кардинально изменилась и теперь представляет собой нечто совершенно иное. Интернет вещей уже незаменим во многих сферах бизнеса, его использование оптимизирует время и затраты. Но его развитие находится только в самом начале своего пути, и концепция интернета вещей постоянно совершенствуется. Цена датчиков снижается за счет увеличения объемов их производства и снижения стоимости комплектующих. Размеры уменьшаются — устройства становятся все более миниатюрными. От направления развития этой сферы зависит жизнь каждого человека.

Ключевые слова: интернет вещей, информационные технологии, автоматизация, системы автоматизации, мехатроника.

Annotation. With the advent of the Internet of Things, every person's life has changed dramatically and now represents something completely different. The Internet of Things is already indispensable in many areas of business, optimizing time and costs. But the trend is only at the very beginning of its path, and the concept of IoT is constantly being improved. The price of sensors is reduced by increasing the volume of their production and reducing the cost of components. The size is decreasing — the devices are becoming more and more miniature. The life of each person depends on the direction of development of this sphere.

Keywords: Internet of Things, Information Technology, Automation, Automation Systems, Mechatronics.

HISTORY OF MICROCOMPUTERS

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Introduction

A microcomputer is a desktop or laptop computer that uses a microprocessor as the only central processor that performs all logical and arithmetic operations. Microcomputers are referred to as computers of the fourth and fifth generation. The main features of microcomputers are the bus organization of the system, as well as high standardization of hardware and software.

The first computers weighed tons and occupied entire rooms, and a huge team of specialists worked on their maintenance. Modern computers are comparable in size to a conventional USB key fob.

Now mini-computers are considered single-board computers of very small sizes. Who was the first, it is impossible to trace — before there were single-board PCs for home use, a whole army of various industrial PCs was created, which were used as embedded systems in production.

The main part

One should consider why the most ordinary user needs a mini-computer today. Most often, either Android or light Linux distributions are

installed on a mini-computer. The performance of such devices is quite sufficient for organizing a media center and playing HD video. Emphasizes multimedia directionality and the presence of an HDMI connector. The device can be easily connected to a modern TV. The same connector is also used for audio transmission.

On any computer, there is at least one USB connector that can be used to connect both a single device and a USB hub.

The connection to the Internet is carried out either via Wi-Fi or via an Ethernet port. There are several the most common models of mini-computers to be considered in our study.

Raspberry Pi

For the first time, the Raspberry Pi computer, or rather, its concept the size of a USB keychain, was introduced in May 2011. Already in the summer of the same year, the alpha version of the board was sent to production, and on August 12, the first batch of devices was produced.

There are two configurations of Raspberry Pi-model "A" and model "B". They have the same processor-Broadcom BCM2835 (ARM11 architecture) with a frequency of only 700 MHz and 256 MB RAM modules, which are placed directly on the processor itself. The BCM2835 processor also contains a graphics core with support for OpenGL ES 2.0, hardware acceleration, and FullHD video. A feature of this computer is the complete absence of a real-time clock.

The difference between the models is the number of USB ports (model "A" has one port, model "B" has two ones) and the presence of an Ethernet port in model "B".

Video output is possible either via an RCA composite connector or via HDMI. The file system is located on an SD, MMC, or SDIO memory card. But usually SD cards are used. This mini-computer can run any OS that supports the ARM processor architecture.

CuBox

Another single-board computer of small size and weighing only 91 grams. This computer is based on the Marvell Armada 510 ARMv7 ARM processor. The amount of RAM is 1 GB, and the video processing is handled by the Vivante GC600 GPU chip, which is compatible with OpenGL 3.0 and OpenGL ES 2.0 and is able to handle 2D / 3D graphics processing. Also on board this computer is a hardware HD decoder (Marvell vMeta HD Video Decoder). Given such features of this computer, its performance is quite enough to work with Full-HD video and use the classic KDE and GNOME interfaces on Linux. And at the same time, the computer consumes only 3 watts of energy! You can install any Linux distribution with kernel 2.6.x and Android 2.2.x. Later versions are also supported.

FXI Cotton Candy

Externally, the FXI Cotton Candy resembles a large USB flash drive with an HDMI output. On board the Cotton Candy is a dual-core Samsung Exynos 4210 processor with a frequency of 1.2 GHz (ARM architecture), 1 GB of RAM and a Mali-400 MP graphics chip. As a storage device, one can use microSD cards (up to 64 GB is supported). Cotton Candy supports Wi-Fi 802.11 b/g/n and Bluetooth 2.1.

It runs Android 4.0 Ice Cream Sandwich, but you can install any system that supports the ARM architecture, such as Linux.

PandaBoard

PandaBoard is positioned not as a mini-PC, but as a board for mobile device developers. The board comes with a TI OMAP 4460 processor with two ARM Cortex-A9 cores. The processor operates at a frequency of 1.2 GHz, the amount of RAM is 1 GB, and there is a full-size SD card slot on board. Video processing is handled by the built-in PowerVR SGX540 processor. The highlight of the board is the RS-232 serial port. The board comes without any software, but any Linux or Android distribution is supported.

Intel Compute Stick

A very interesting solution from Intel is the INTEL Compute Stick BOXSTCK1A32WFC microcomputer. As the slogan on the Russian-language website "Small keychain. Big surprise". The computer is made in the format of an HDMI dongle, i.e. it is connected directly to the HDMI input of a TV or monitor.

The device is based on a 4-core SoC Atom Z3735F, the chip belongs to the Bay Trail - T family of Silvermont architecture. The frequency of operation is 1.33 GHz, in Burst mode it rises to 1.83 GHz (in single-threaded load mode). In idle mode, the frequency drops to 500 MHz. The second-level cache memory is 2 MB.

The graphics subsystem is represented by the Intel HD Graphics (Bay Trail) solution, which belongs to the 7th generation (similar to those used in Ivy Bridge processors), but includes only 4 execution units. Suitable for those who want to have an office at hand, and with the ability to connect to any TV or monitor with an HDMI input.

Conclusion

To sum up, we can say that the performance of even the best mini-PCs is quite comparable to fairly modern desktops, but when it comes to games or 3D applications, these devices almost lose their appeal. There is a way out-buying an external unit with a video card, but in this case it is easier to do with a regular desktop PC.

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Аннотация. На данный момент одноплатные миникомпьютеры имеют очень узкую направленность из-за низкой производительности. Им не хватает полноценной видеокарты, а также встроенного в процессор высокопроизводительного видеочипа. Однако для интернет-серфинга эти устройства могут послужить заменой крупногабаритным полноценным компьютерам. Если мы рассмотрим его более подробно, то увидим, что у каждого из компьютеров есть свои преимущества: цена, производительность, габариты или узконаправленный круг выполняемых задач, для которых сделано то или иное устройство.

Ключевые слова: мини-компьютер, информационные технологии, компьютер, периферийные устройства, карманный компьютер.

Annotation. Atthemoment, single-board minicomputers have a very narrow focus due to low performance. They lack a full-fledged video card, as well as a high-performance video chip built into the processor. However, for Internet surfing, these devices can serve as a replacement for large-sized full-fledged computers. If we consider it more detaily, we can state that each of the computers has its own advantages, whether it is price, performance, size, or a narrowly focused range of tasks performed, for which a particular device is made.

Keywords: Minicomputer, Information Technology, Computer, Peripherals, pocket computer.

UDC 621

INFORMATION SYSTEMS

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Introduction. The task of accumulating, processing and distributing information the humanity has faced at all stages of its development. For a long time, the main tools for solving this problem were the human brain, language, and hearing. Today, information is considered as one of the main resources for the development of society, and information systems - as a means of increasing the productivity and efficiency of people's work [2].

The main part.

Information system.

A system is understood as any object that is simultaneously considered both as a single whole and as a set of disparate elements united in the interests of achieving the set goals.

In computer science, the term "system" is widely used and has many meanings. It is most commonly used for a variety of hardware and software applications. A system can be described as the hardware of a computer. The system can also be defined as a set of programs for solving specific application problems, supplemented by procedures for managing documentation and calculations [1].

The addition of the word "information" to the term "system" reflects the purpose of its creation and operation. Information systems provide the collection, storage, processing, search and output of information necessary for making decisions on tasks in all areas. They help to analyze problems and create new products.

Information system is an interconnected system of tools, methods, and personnel used to store, process, and output information to achieve a specific goal [3].

The modern understanding of the information system implies the use of a personal computer as the main technical means of information processing. In large organizations, the technical base of an information system, in addition to a personal computer, can be a central computer.

It is necessary to understand the difference between computers and information systems. Computers equipped with specialized software tools form the technical base and tool for information systems. An information system is impossiblewithout the interaction of personnel with computers and telecommunications.

Information system processes.

Processes that ensure the operation of the information system for any purpose:

- Entering information from external or internal sources;
- Processing the entered information and presenting it in a convenient form;

- Output of information for presentation to consumers or transmission to another system;

- Feedback is information that has been processed by people in the organization to correct the information entered.

Information system properties:

- Any information system can be analyzed, built and managed based on the general principles of system design;

- The information system is dynamic and evolving;

- When setting up an information system, you must use a systematic approach;

- The output of an information system is the information on which decisions are based;

- Information system should be perceived as a human-computer information processing system [2, 3].

Structure and classification of information systems.

The structure of an information system consists of a set of its individual parts, the so-called subsystems. A subsystem is a part of a system that is located on any screen. The overall structure of an information system can be considered as a set of subsystems, regardless of its scope. In this case, it is called a structural feature of the classification, and the subsystem is called a security feature. Thus, the structure of any information system can be represented as a set of supporting subsystems [2, 3].

Among the supporting subsystems, as a rule, there are information-technical, technical, mathematical, software, organizational and legal ones.

Conclusion. The technology of working in a computer information system is available to a specialist to understand the non-computer field and can be successfully used to control and manage the processes of professional activity.

What can be expected from the introduction of information systems:

- Obtaining more rational solutions to management problems through the introduction of mathematical methods, intelligent systems, etc.;

- Deliverance of employees from routine work through automation;

- Ensuring the accuracy of the information;

- Replacing paper media with magnetic disks or tapes, this leads to a more rational organization of information processing on a computer and a reduction in the volume of documents on paper;

- Improving the structure of information flows and the document management system in the company;

- Reducing the cost of manufacturing products and services;

- Providing unique services to consumers;

- Searching for new market niches;

-   Retainingcustomersand suppliers by providing them with various discounts and services.

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Аннотация. В статье раскрываются понятия информации, информационных систем и процессов, обеспечивающих их работу. Описываются свойства, структура и классификация информационных систем, так же даются определения таким понятиям, как обратная связь, выходной продукт информационной системы. Делается вывод, что информационная система – это взаимосвязанное сочетание средств, процессов, методов и людей, участвующих в информационных процессах. Это показывает нам, что информационные системы и технологии являются неотъемлемой частью нашей жизни.

Ключевые слова: безопасность, информация,информационная система (ИС), компьютерная информационная система, программное обеспечение, аппаратное обеспечение, персональный компьютер (ПК).

Annotation. The article discloses the concepts of information, information systems and processes that ensure their operation. Properties, structure and classification of information systems are described, and definitions are also given to such concepts as feedback, output product of the information system. It is concluded that the information system is an interconnected combination of tools, processes, methods and people involved in information processes. This shows us that information systems and technologies are an integral part of our lives.

Keywords: Security, Information, information system (IS), computer information system, Software, Hardware, personal computer (PC).

CREATING A VIRTUAL LAB FOR CONDUCTING PENETRATION TESTING USING THE BASH COMMAND SHELL

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In education and science, incredibly promising and truly effective virtualization technologies are essential. The use of these technologies significantly reduces the cost of IT tools, provides their flexibility and scalability. Virtualization enables easier management of workloads, improves performance, and increases resources availability.

The development of virtual laboratories is the most important direction in teaching modern high technologies and training highly qualified scientific personnel. Virtualization technologies, a dynamically scalable way to access software and computing resources in the form of a service provided via the Internet, in which students do not need any special knowledge about the software and hardware infrastructure of a virtual computer laboratory or skills to manage this technology [3].

A separate and important advantage is the possibility of using a virtual laboratory in distance learning, which is relevant in our time. A single virtual lab server can serve a large number of students. It will facilitate the work of teachers who connect to the server from the workplace, where the experiment is demonstrated and the task is monitored. Virtual laboratories are important for teaching and conducting practical classes [4].

An example of using virtualization is the ability to run multiple operating systems on a single computer. Each guest operating system (vm1 - vm3) operates with its own set of logical resources, the provision of which from a common pool is controlled by the host operating system. Recall that the device on which the virtual engine is built is called the host machine, and the virtual OS is called the guest machine. This virtual OS is controlled by firmware or software called a hypervisor. Type 1 hypervisor instances are RTS hypervisor, LynxSecure, Oracle VM, VirtualLogic VLX, Sun xVM Server, does not own any host OS because they are installed on a bare system. A type 2 hypervisor is a software interface that emulates a machine that the system regularly interacts with. The Type 2 hypervisor instances are KVM, VMware Fusion, Microsoft Hyper V, Windows Virtual PC, Virtual Server 2005 R2, and VMware Workstation (pict. 1). In addition, data transmission networks, storage networks, platform and application software can be virtualized.
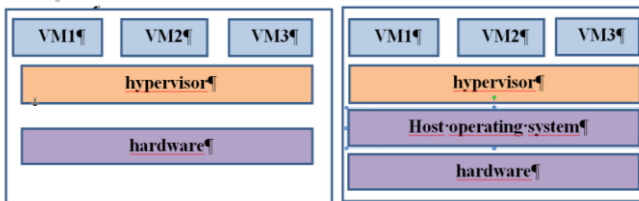
Picture 1 – Hypervisor of the first type and Hypervisor of the second one

Creating a pentest lab

One of the methods of protecting information assets and identifying security vulnerabilities is penetration testing (pentest). To increase the effectiveness of penetration testing training, you need an environment in which you can practice without breaking anything in the real network. The virtual environment allows to more closely monitor the behavior of each system during an attack. This provides additional information about what and how compromises the security of the system. This is the purpose of creating a laboratory for testing, which is a small local network that implements all sorts of attacks.

The scope of penetration testing is quite extensive, since every system located in the information environment is at risk. Network devices and the systems they run, individual web applications, operating systems, etc. need a pentest. In this regard, the main characteristic of the created laboratory should be its versatility, which allows us to study various types of attacks [5].

The purpose of this work is to create a virtual laboratory for testing malware such as backdoor using the second-level hypervisor Virtual Box, Pict. 2. This virtualization software product is designed for various operating systems, for example, Kali Linux (1), Astra Linux (2) and Linux Mint (3) are used, and a demonstration of its performance on specific examples is shown.
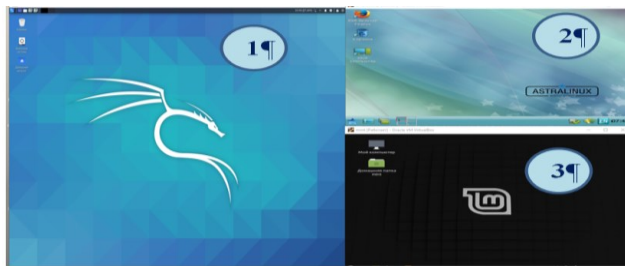
Picture 2 – Architecture of virtual computer lab

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The instance shows a virtual lab running on Linux, so it is impossible to do without the Bash shell (Bourne Again Shell), which is one of the most powerful and popular command interpreters. The presence of Bash is no less important for the full functioning of Linux operating systems than the kernel or the working environment. The command-line interface is the main tool for working with the Linux OS. The advantage of this interface is the possibility of "more in-depth" management of system resources. The functions of the bash shell command include: automating the launch of batch files, performing advanced administrative functions and troubleshooting many problems in the operating system, remote control of computers and servers, backing up and uploading copied files to a remote server, network and computer administration [2].

On machines running the Linux operating system, you can generate malicious files, as well as establish a reverse connection using the bash command interpreter. Part of the software products included in the Kali Linux application package allows to evaluate the network security system, simulating all known methods used by intruders to penetrate distributed information systems, and thereby detecting weaknesses in the security system.

Algorithm for conducting penetration testing using the backdoor method.

The entire virtual lab will be hosted in the second-level hypervisor VirtualBox. Currently, most PCs can easily support multiple guest VMs. Kali Linux was chosen as the attacking machine, and Linux Mint and Astra Linux were installed as the target for unauthorized access. All operating systems are Linux-based systems based on the Debian distribution. In VirtualBox, there are several options for configuring the network, but in this case, the best one is the "Virtual Host Adapter" [1].

Given that the attacker often does not know the main features of the network and the devices in it, first of all, it is necessary to investigate the object of the attack, and only then, based on the results of the study, to break in. To find out the IP addresses of a machine on Kali Linux, Linux Mint, and Astra Linux, the ifconfing command is used. The IP address of Kali Linux is as follows: 192.168.200.65

This command is introduced on Linux Mint and Astra Linux. The reverse shell connection is established via the TCP protocol, at the IP *address* 192.168.200.65 and port 8080, to which the connection is made:

bash -i >& /dev/tcp/192.168.200.65/8080 0.&1

To activate waiting for incoming connections on port 8080, you need to write the following command on Kali Linux:

nc-vv-l-p 8080

The command-line netcat (or nc) utility reads and writes data over network connections using the TCP protocol. The –vv key allows to output detailed information, and the –l, -p key indicates that a specific port 8080 is being listened to.

By pressing the "Enter" key on Linux Mint and Astra Linux, netcat reports that a port is being listened to and a reverse connection has been established on Kali Linux and the goal has been achieved: full control over the machines with Linux Mint and Astra Linux has been achieved.

It can be concluded that virtualization makes real what is not really real by applying the flexibility, convenience of software features and services, replacing a similar implementation in software. In this article, we presented a method for creating a virtual lab using VirtualBox with Linux OS. One of the main components-bash – allows running commands for testing the penetration of Linux distributions. The instance described how to obtain data access and remote connection to the system for full management and control. The created laboratory is versatile and can be used to test specific systems or applications in an autonomous digital environment.

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Аннотация. В этой статье рассматриваются усовершенствованные технологии виртуализации. Технология виртуализации позволяет управлять виртуальным экземпляром компьютерного устройства на уровне, отличном от реального оборудования. Чаще всего имеется в виду одновременная работа нескольких операционных систем в одной компьютерной системе. Технология виртуализации известна своей простотой настройки и

оптимизацией затрат для создания среды с более высокой эффективностью обработки.

Развитие виртуализации повлияло на продвижение виртуальных лабораторий, которые являются важнейшим направлением обучения современным высокотехнологичным технологиям и подготовки высококвалифицированных научных кадров. Кроме того, речь идет о создании виртуальной лаборатории по дисциплине «Информационная безопасность». Описана возможность виртуализации процессов анализа и тестирования системы на уязвимость. В итоге, тестирование на проникновение позволяет специалистам по кибербезопасности выявлять уязвимости и слабые места в системе безопасности, которые могут быть использованы злоумышленником как на виртуальном, так и на физическом уровне. Приведен пример создания виртуальной лаборатории для удаленного доступа к машине. Это можно сделать с помощью довольно коротких и простых команд в оболочке bash. Bash – мощный интерпретатор команд, позволяющий выполнять огромное количество функций.

Ключевые слова: виртуализация, гипервизор, виртуальные машины (ВМ), виртуализация ОС, тестирование на проникновение.

Annotation. This article deals with very advanced virtualization technologies. Virtualization technology allows to manage a virtual instance of a computer device at a level that is separate from the real hardware. Most often, this refers to the simultaneous operation of several operating systems in a single computer system. Virtualization technology is known for its ease of configuration and cost optimization to create an environment with higher processing efficiency.

The development of virtualization has influenced the one of virtual laboratories, which are the most important direction in teaching modern high-tech technologies and training highly qualified scientific personnel. In addition, we are talking about the creation of a virtual laboratory for the discipline "Information Security". The possibility of virtualizing the processes of analyzing and testing the system for vulnerabilities is described. After all, penetration testing allows cybersecurity specialists to identify vulnerabilities and weaknesses in the security system that can be exploited by an attacker, both at the virtual and physical level. An example of creating a virtual lab for remote access to a machine is given. This can be done with fairly short and simple commands in the bash shell. Bash is a powerful command interpreter that allows to perform a huge number of functions.

Keywords: virtualization, hypervisor, virtual machines (VMs), OS virtualization, penetration testing.

UDC 621.396.676
MULTICHANNEL ANTENNA WITH POLARIZATION DIVERSITY

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1. Introduction

The existing trends in increasing the efficiency of radio equipment, including those used on mobile objects, lead to the need to develop and create antenna devices that more fully use the potential properties of the electromagnetic field. Special attention should be paid to small-sized antenna devices, the quality characteristics of which are determined not only by the possibility of forming the required radiation directivity, that is, by the amplitude directional pattern, but also by the possibility of forming a given type of polarization structure of the electromagnetic field, both during radiation and when receiving [2].

At present, antennas with fixed polarization of radiation are most often used in radio communication systems, which limits the maximum achievable capabilities of radio systems, both in bit rate and in the stability of radio communication at maximum distances. One of the ways to increase these capabilities is the use of multichannel antennas with polarization channel spacing, by using antennas with orthogonal types of polarization of the radiation field [1].

Therefore, the aim of the work is to develop a two-channel antenna with polarization separation of channels.

2. Main part

The representation of an elliptically polarized wave as the sum of two circularly polarized waves is very useful when considering the transfer of energy between two antennas with respect to polarization diversity. If two arbitrarily polarized antennas are used, then the relative power at the output of the matched receiving antenna is determined by the following expression [2].

$$\frac{P}{P_{\text{MAX}}} = \frac{\left|E_1^{\text{ПР}} E_2^{\text{ПР}} + E_1^{\text{ЛЕВ}} E_2^{\text{ЛЕВ}}\right|^2}{\left[\left(E_1^{\text{ПР}}\right)^2 + \left(E_1^{\text{ЛЕВ}}\right)^2\right] + \left[\left(E_2^{\text{ПР}}\right)^2 + \left(E_2^{\text{ЛЕВ}}\right)^2\right]} \tag{1}$$

where 1, 2 — indices characterizing the field of the first and second antennas;

P — is the actual power transmitted from antenna 1 to antenna 2.

P_{MAX} — represents the highest received power when fully polarized matched.

Based on expression (1), it was established that, for the transmission of the maximum power from the signal source to the receiver, it is necessary that the receiving and transmitting ones be consistent in polarization. For a quantitative assessment of the polarization matching of antennas, the polarization transmission coefficient is introduced [1]. The calculated expression for the polarization transfer coefficient through the parameters of the polarization ellipse is written as follows:

$$\begin{aligned}
\xi(\beta_A, k_{\ni A}, \beta_e, k_{\ni e}) &= \sqrt{\frac{\cos^2\beta_A + k_{\ni A}^2 \sin^2\beta_A}{1 + k_{\ni A}^2}} \sqrt{\frac{\cos^2\beta_e + k_{\ni e}^2 \sin^2\beta_e}{1 + k_{\ni e}^2}} + \\
&+ \sqrt{1 - \frac{\cos^2\beta_A + k_{\ni A}^2 \sin^2\beta_A}{1 + k_{\ni A}^2}} \sqrt{1 - \frac{\cos^2\beta_e + k_{\ni e}^2 \sin^2\beta_e}{1 + k_{\ni e}^2}} \times \\
&\times \exp\left[j\left(\arctan\frac{2k_{\ni A}}{(1 - k_{\ni A}^2)\sin 2\beta_A} + \arctan\frac{2k_{\ni e}}{(1 - k_{\ni e}^2)\sin 2\beta_e} \right) \right].
\end{aligned} \tag{2}$$

Let's analyze (2) for different types of antennas. The incident wave passing through the radio path hits the receiving antenna with certain parameters of the polarization ellipse $0 \le \beta_e \le \pi$ and $-1 \le k_{\ni e} \le 1$. In fig. 1 shows the characteristic dependences for $\beta_e = 0$, for some types of antennas. The following types of antennas were selected for the analysis: antennas with fixed, linear (horizontal and vertical) polarization; fixed circular (left-handed and right-handed) polarization; developed type of antenna with switchable polarization (linear – vertical, horizontal and circular – left-sided, right-sided).

For antennas with left-side and right-side polarization, as well as for antennas with vertical and horizontal polarization, a decrease in the polarization transmission coefficient $|\xi|^2$ to 0 is observed (Fig. 1), which indicates the absence of reception at certain parameters $k_{\ni e}$ and β_e the polarization ellipse of the incoming wave.

Thus, for antennas of orthogonal types of polarization, there will always be such parameters of the polarization ellipse of the incoming wave when the polarization gain is zero, this is called polarization diversity. This property is used to build multi-channel antennas for MIMO systems in order to increase the transmission rate of the telecommunication system.
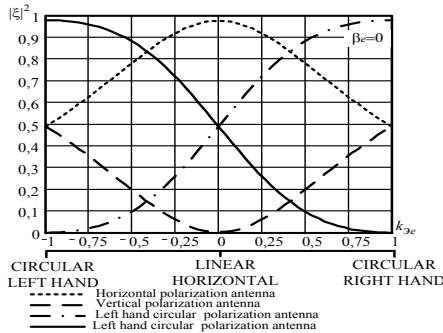
Figure 1 – Dependence of the polarization transmission coefficient on the parameters of the polarization ellipse of the incoming wave at $\beta_e = 0$ for the selected types of antennas

3. Conclusions

Based on the study, the following results were obtained. A method for creating a multichannel antenna with polarization separation of channels for MIMO systems has been substantiated. For this, the design of a two-channel emitter with orthogonal types of polarization, which is able to form a field of linear or circular polarization, is best suited. The use of two antennas of orthogonal polarization will make these channels independent from each other, which will significantly increase the throughput of the radio channel as a whole due to a more complete use of the potential properties of the electromagnetic field.

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Аннотация. В работе рассматриваются вопросы разработки двухканальной антенны с поляризационным разнесением каналов.

Проведено математическое моделирования с целью определения уровня взаимного влияния каналов.

Ключевые слова: антенна, многоканальная антенна, ортогональные поляризации, поляризационное рассогласование.

Annotation. The paper deals with the development of a two-channel antenna with polarization diversity. Mathematical modeling was carried out in order to determine the level of mutual influence of the channels.

Keywords: antenna, multi-channel antenna, orthogonal polarizations, polarization mismatch.

UDC 004

REVIEW OF METHODS FOR PROCESSING ECG RESULTS

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Automatic electrocardiogram (ECG) analysis has been the subject of intensive research over the past three decades in the field of biomedical engineering.

Heart cells are normally electrically polarized. Their inner sides are negatively charged relative to their outer sides. These heart cells can lose their normal negativity in a process called depolarization, which is the main electrical activity of the heart. This depolarization spreads from cell to cell, producing a wave of depolarization that can be transmitted throughout the body. heart. This depolarization wave creates a flow of electric current, and it can be detected by holding the electrodes on the surface of the body. Once depolarization is complete, the heart cells are able to restore their normal polarity through a process called re-polarization. This is also felt by the electrodes. "The ECG analysis is of particular interest due to its role as an effective non-invasive research method that provides useful information for the detection, diagnosis and treatment of heart diseases" [9, p. 4].

Currently, outpatient electrocardiography (ECG) is studied because it provides accurate and rich information from a clinical point of view for the diagnosis of heart diseases. "Automatic analysis (AECG) can significantly help the doctor by reducing the time spent on analyzing records with a duration of 24 and 48 hours" [7, p. 913-948].

The ECG signal has a time periodicity that allows you to determine an elementary rhythm made up of specific signals that periodically appear in time. Figure 1 shows the heartbeat and the corresponding waveform labels. The study of the amplitudes and patterns of the waveforms is the basis for the analysis of the ECG signal. For example, it can be easily shown that the heart rate is estimated after detecting the QRS complex from a sequence of beats.
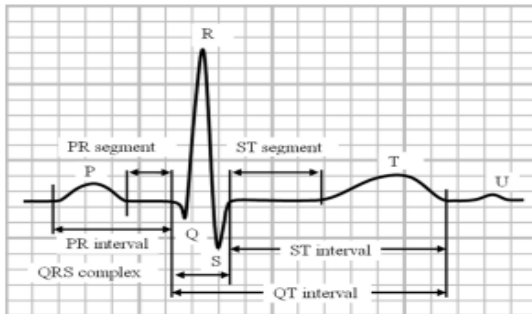
Figure 1 – Heartbeat observed on an ECG with the determination of its elementary forms and intervals

In the same way, the time-distance between two consecutive QRS complexes, known as the RR interval, is used to detect premature shocks. We can extend this analysis to other conditions, such as the deviation of the ST segment from the long period required for early diagnosis of ischemia. As a result, reliable ECG analysis directly depends on the results of ECG rhythm segmentation [6], [9].

The precise determination of the QRS complex, in particular the precise determination of the peak of the R wave, is important in the computer analysis of the ECG. However, this is often difficult to achieve. "Noise pollution caused by changes in baseline drifts, motion artifacts, and muscle noise is common" [8, p. 85]. In addition, "morphological differences in the ECG waveform increase the difficulty of detecting QRS due to the high degree of heterogeneity of the QRS waveform and the difficulty of differentiating the QRS complex from high peak P or T waves" [10, p. 702].

Many different approaches have been used to improve the accuracy of QRS detection.

An earlier method for analyzing the ECG signal was based on the time domain method. But this was not always enough to study all the features of ECG signals. Thus, a frequency representation of the signal was required. To achieve this, the Fast Fourier Transform method is applied. But an

unavoidable limitation of the FFT is that the method failed to provide information about the exact location of the frequency components over time. Since the frequency content of ECGs varies over time, the need to accurately describe the frequency content of ECGs according to their location in time is essential. This justifies the use of time-frequency representation in quantitative electrocardiology. The immediate tool available for this purpose is the Short-term Fourier Transform (STFT). But the main drawback of STFT is that its time frequency accuracy is not optimal. Therefore, it became necessary to find new methods of analysis that would be more accurate, showing the picture more informative.

Most papers in this field use heuristic rules to segment the pulse automatically from the ECG signal after a suitable preprocessing technique is done, and many authors emphasize the advantages of the wavelet transform.

A wavelet transform is an integral transformation that is a convolution of a wavelet function with a signal. The wavelet transform translates a signal from a time representation to a frequency-time representation. A method for converting a function (or signal) into a form that either makes some values of the original signal more amenable to study, or allows you to compress the original data set. The wavelet transform of signals is a generalization of spectral analysis. Wavelets this is a generalized name for mathematical functions of a certain form that are local in time and frequency, and in which all functions are obtained from a single base by changing it (shifting, stretching). Wavelet transforms have all the advantages of Fourier transforms. The wavelet bases can be well localized in both frequency and time. When identifying well-localized multi-scale processes in signals, only those scale levels of decomposition that are of interest can be considered. Also, the basis wavelets can be implemented by functions of different smoothness. But as a disadvantage of the wavelet transform, we can single out the relative complexity of the transformation.

"The use of the Hilbert transform in ECG analysis was first described by Bolton and Westphal" [1, p.281-286] [2, p. 377-384] [3, p. 463-466]. In general, this ECG waveform analysis method uses the vectorcardiograph and polarcardiograph representations and explores the concept of the pre-envelope and the envelope of the real waveform given by the Hilbert transform. They developed a prototype of a two-stage QRS detector based on detecting the zero intersection in the Hilbert transformed data.The original ECG waveform coincides with a large value in its envelope.

In their paper *"Using the Hilbert transform in the analysis of ECG signals" (author D. Beniteza, P. Gaydeckia A., Zaidib A., A.P. Fitzpatrickb)*, the authors present a new approach to the detection of Co using other

properties of the Hilbert transform. The new algorithm uses the 6th ECG signal differential and its data, transformed by Hilbert into the 6th region of high probability, to find the P-peaks in the ECG signal form. Similar to the method developed by Bolton and Westphal, the second-stage detection algorithm uses these initial estimates to determine the actual ECG P-peaks in the wave. This has a number of advantages over the previously described techniques. The undesirable effects of large peak waves T and N are minimized, and the new algorithm works perfectly in the presence of significant noise pollution. Moreover, unlike the Bolton and Westphal method, the determination of the envelope and the preliminary envelope of the data is not required.

Using the MIT-BIH arrhythmia database, the algorithm worked very efficiently. The QRS peak is detected in more than 99% of cases, even in the presence of significant noise pollution. Currently, the algorithm works significantly better with the MLII configuration than with other ECG outputs.

In the study *"Analysis of ECG signals through Hidden Markov Models" (authors in Rodrigo. Andreao, Bernadette Dorizzi Jerome and Budi)* the authors refer to the classification approach of Coast et al.

In the classification approach of *Coast et al* [4], the topology of HMM (hidden Markov models) preserves "the beat of the structural characteristics, while the model parameters are assumed taking into account the statistical nature of the observations" [5, p. 74]. In addition, intra-individual variability in beat length, especially due to heart rate variations, can be incorporated into the state transitions model. Another advantage of XMS is their ability to perform three different tasks simultaneously: beat detection, segmentation, and classification. In addition, replace the XM heuristic rules commonly used for waveform detection, which usually requires thresholds. After *Coast et al.*, other work using HMM was implemented specifically for the isolated beat segmentation problem aimed at detecting the P wave.

In their article, the authors use xm to determine beats and segmentation:

1) Simulation of waveforms (not beats) using the generic HMM program (trained on examples from several individuals). Thus, XMS are trained taking into account the morphological diversity of each waveform.

2) Better accuracy of waveform segmentation by adapting a universal model for each individual user. "The model adaptation is performed in an unsupervised way, eliminating the manual marking waveform" [5, p. 20].

As for the classification problem, the system in this study takes advantage of two complementary approaches: statistical and heuristic. Each

class of abnormal shocks (for example, premature ventricular shocks) can be accounted for only by adding the associated new rules.

Finally, a merge strategy that explores information obtained from multiple channels is proposed to represent a post-processing phase aimed at performing beat segmentation and improving the reliability and efficiency of classification tasks.

In their experiment, the authors studied the accuracy of beat segmentation, showing that their results compare favorably with other works in the same database. The system was further evaluated in terms of the classification of PVC runouts.

Thus, in this paper describes several existing methods for analyzing ECG results, describing the results of studies based on these methods. This area of analysis of ECG results, diagnostics and classification based on the information received will be developed, finding new methods that will improve modern AEGs to improve the efficiency and efficiency of cardiologists.

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Аннотация: Эта статья является обзорной. В статье вкратце рассказывается об особенностях данных, полученных в результатеэлектрокардиограммы.В данном обзоре рассматриваются существующие описанные методы анализа результатов, полученных посредствомэлектрокардиограммы (ЭГК), такие как Быстрое Преобразование Фурье (БПФ), Вейвлет-преобразование, преобразование Гильберта, скрытые Мартовские модели (СММ). Описаны основные свойства и принципы, подходыкаждого из указанного метода к анализу полученных результатов ЭКГ, описаны результатыв ходе исследований на основе указанных методов.

Ключевые слова: ЭКГ, электрокардиограмма, преобразования Гильберта, Быстрое Преобразование Фурье, Вейвлет-преобразование, скрытые Марковские модели.

Annotation. This article is an overview. The article briefly describes the features of the data obtained as a result of the electrocardiogram. This review examines existing described methods for analyzing electrocardiogram (EGC) results, such as Fast Fourier Transform (FFT), Wavelet Transform, Hilbert Transform, Hidden March Models (HMM). Basic properties and principles, approaches of each of the above methods to analysis of the obtained ECG results are described, the obtained results are described in the course of studies based on the above methods.

Keywords: ECG, electrocardiogram, Gilbert's transformations, Fast Transformation of Fourier, Wavelet transformation, hidden Markov modeliany, hidden Markov models.

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SMART MARKING READER

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Introduction

Since 2019, the Federal Law "On the basics of state regulation of trade activities in the Russian Federation" has been approved, which obliges marking of various categories of goods, from cigarettes to tires and shoes. This approach allows get information about the product and helps to prevent counterfeit products, which in 2019 revealed more than 6 million units. The ability to identify each unit of goods makes marking an integral part of the trade turnover [5-8].

At the moment, there are many types of marking readers, depending on the field of application, they are divided into: manual, industrial, stationary, embedded, scanners with the possibility of integration into other equipment. The most expensive of them are industrial ones, since they must provide a wide reading range (they can read up to 1 meter), and at the expense of optics, they must be able to scan even deformed and poorly printed codes without accurately pointing at them. The implementation of high performance indicators, such as the reading speed of up to 200 scans/sec and reading the code at a distance of one meter in streaming conditions makes these devices expensive products.

In connection with the above, the purpose of this work is developing a smart marking reader. As the basis of marking reader, machine learning is used — an approach that has become relevant in the last decade — in particular, the use of neural networks for classification tasks.

Calculation of the necessary processing power

In organizing the operation of the device, we are guided by two main criteria: the probability of correct recognition and the time it takes to get the result. In the case of neural networks, the accuracy depends on the number of hidden layers, the epochs of training, the type of selected activation function, and in general on its configuration, due to the number of hidden layers, the activation coefficient, etc.

We will estimate the computational resources required to implement a neural network consisting of 784 inputs, since the incoming images will form a matrix of 28×28 pixels, 10 outputs and 100 hidden layers. The learning speed of a neural network is estimated by the number of mathematical operations required for training and correct operation of the neural network (INS). To numerically estimate the calculation time, we will use the characteristics of a processor with a Single Core ARM11 architecture with a clock frequency of 1 GHz.

The operations of addition and subtraction, multiplication and division will be considered pairwise equivalent, and the operations for calculating the exponent will be calculated separately. To balance the computational

operations, we introduce the coefficients: α – addition/subtraction; β — multiplication/division; γ — calculation of the exponent.

The number of operations in a classical neural network consists of the number of forward propagation operations and the number of reverse propagation operations. Since the end device will have an already trained model (architecture and weight coefficients), direct propagation operations will be sufficient for the calculation, they are responsible for object recognition [3].

Let's introduce the notation:

m — number of hidden layers;

n_i — the number of neurons in layer i;

n — the maximum number of neurons in the hidden layers of the network;

n_0 — number of inputs;

n_m — number of outputs.

To calculate the value at the output of one neuron, we express the weighted sum of the inputs $net = \sum wx$ and calculate the value of the neuron activation function, which in our case is the sigmoid $f(net) = \dfrac{1}{1 + e^{-net}}$.

Respectively, for the sigmoid we get the number of operations equal to $\alpha + \beta + \gamma$.

Let's express the weighted sum of the inputs of one neuron of the first INS layer: $net_{11} = \sum\limits_{i=1}^{n_0} w_1 x_1$, from here, the number of multiplications will be n_0, and the number of additions will be expressed as $(n_0 - 1)$. We balance the operations with coefficients and get the expression:

$$\alpha(n_0 - 1) + \beta n_0 = n_0(\alpha + \beta) - \alpha.$$

Next, we express the output value of one neuron of the first layer, taking into account the influence of the activation function:

$$S_{11} = n_0(\alpha + \beta) - \alpha + \alpha + \beta + \gamma = n_0(\alpha + \beta) + \beta + \gamma.$$

Therefore, to calculate the operations of the entire first layer, we need to multiply this expression by the number of neurons of this layer:

$$S_1 = n_1 n_0(\alpha + \beta) + n(\beta + \gamma) \le n_1 n_0(\alpha + \beta) + n(\beta + \gamma).$$

We will estimate the number of operations based on the largest parameters in order to track the most resource-intensive option. Therefore,

the number of neurons in each hidden layer is replaced by their maximum number. For the layers from the second to (m − 1), we get the expression:

$$S_i = n_i n_{i-1}(\alpha + \beta) + n_i(\beta + \gamma) \leq n^2(\alpha + \beta) + n(\beta + \gamma).$$

For the final layer, we define the expression:

$$S_m = n_m n_{m-1}(\alpha + \beta) + n_m(\beta + \gamma) \leq n n_m(\alpha + \beta) + n_m(\beta + \gamma).$$

Taking into account the obtained expressions, we bring to a general form the number of operations for direct propagation:

$$S \leq n_0 n(\alpha + \beta) + n(\beta + \gamma) + (m-2)(n^2(\alpha + \beta) + n(\beta + \gamma)) + n n_m(\alpha + \beta) + n_m(\beta + \gamma).$$

$$784 \cdot 783(9+9) + 783(9+27) + (100-2) \cdot (783^2 \cdot (9+9) + 783(9+27)) + 783 \cdot 10(9+9) + 10(9+27) = 1{,}095 \cdot 10^9;$$

According to the last formula, $S \leq 1{,}095 \cdot 10^9$ the clock cycles were obtained. Thus, at a processor clock frequency of 1 GHz, the calculation time for direct error propagation will be approximately 1 s. The number of neurons in the hidden layer is assumed to be 783, which is the maximum number for the input image of 28×28 pixels [6]. The actual number of neurons is much smaller, so the processing of forward propagation operations takes into account the option with the maximum computational load.

Neural network development

We implement a neural network for recognizing symbolic images. To increase the versatility of readable fonts, the algorithms will be trained on the example of handwritten text.

The database is called "MNIST', it contains two sets of data. Labeled instances that are used to train the neural network and a test set of data, also labeled, to check the correctness of the neural network. Marking implies that there is a correct answer for each instance [9]. The presence of a test data set ensures that the algorithm has not encountered it before. Thus, learning the algorithm is reduced to the concept of learning with a teacher.

We will conduct a trial test on a small amount of data from the MNIST test set consisting of ten digits. Before creating a loop of iterating through test records, we will test the algorithm on the example of a single test. Picture 1 shows the results of the trained neural network using the example of the handwritten number "1".

Picture 1 — Neural network results

The precision of the neural network using the full data set is shown in picture 2. According to the results of testing the neural network, the overall efficiency of its work was 0.9688, i.e. the recognition accuracy is close to 96,9%.

Picture 2 — The precision of the neural network using

Device testing model

The Raspberry PI Zero W single-board computer and the Raspberry Pi Camera Board V2 were chosen as the layout for testing the neural network.

The Raspberry PI Zero single – board computer, a representative of the Raspberry PI family of single-board computers from the Raspberry Foundation, was chosen as the control device. Devices of this series are widely used due to their size and price – performance ratio.

The main element of a single-board computer is a single-core ARM processor Broadcom BCM2835 with an ARM1176JZ-F core. This processor was used in early models with a frequency of 700 MHz and specifically for Zero was improved to a frequency of 1 GHz. The processor

and memory are arranged according to the "package-on-package" technology – the processor is on the bottom, and the memory module is on top of it to save space on the board. Power is supplied to the board via a common micro-USB connector. In the process of miniaturization, we had to abandon the built-in memory, so the board has a slot for a microSD memory card, which stores all the information, up to the operating system. This approach is convenient because you can choose the amount of memory yourself, calculating the optimal amount of resources for a specific task [1].

Since the control device must organize the operation of the neural network in the process, its training on Raspberry will take a significant amount of time, however, computing resources should be sufficient to use it in the future without loss of performance.

Conclusion

A neural network is developed as the basis of the device software. The neural network was trained with a teacher on a sample of handwritten MNIST numbers consisting of 60 thousand images, testing was conducted on a sample consisting of 10 thousand elements [10-11]. The result of the accuracy of the trained algorithms was 96.9%. In the final version, the program is a trained neural network consisting of 784 output neurons, 100 hidden layers, 10 outputs with a learning factor of 0.2. The Raspberry PI Zero W single-board computer and the Raspberry Pi Camera Board V2 camera module are selected as the layout of the device under development.

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Аннотация. Разработано интеллектуальное устройство считывания маркировок. В качестве основы устройства используется машинное обучение — подход, который стал актуален в последнее десятилетие — в частности, применение нейронных сетей для задачи классификации.

Ключевые слова: нейронная сеть, маркировка, разработка устройства, товарооборот.

Annotation. An intellectual marking reader has been developed. The device is based on machine learning-an approach that has become relevant in the last time — in particular, the use of neural networks for classification tasks.

Keywords: neural network, marking, device development, trade turnover.

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AUTOMATED SMART HOME MONITORING SYSTEMS

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Modern housing is saturated with life support systems and a variety of household appliances that facilitate our existence and provide maximum comfort. This includes heating, electricity, hot and cold water, and natural gas. Our life already seems unthinkable without a refrigerator, an automatic washing machine, a microwave oven, televisions, computers, tablets and smartphones. "Smart Home" is a complex automation of all home equipment, for performing everyday tasks: regulation and control of lighting and temperature in rooms; monitoring the condition of water and gas pipelines, protection against leaks; protection against unauthorized entry; fire alarm; control of household appliances from electric lamps to microwaves and refrigerators, etc.

The Smart Home system attracts the average layman, because it allows to choose a ready-made package and customize it to your needs using the control center, which can be, for example, a smartphone. Smart devices communicate with the control center via Wi-Fi, Bluetooth, and ZigBee [2, p. 3].

Home management is built from "smart" things. These are not ordinary electrical appliances, but devices that can communicate with each other and the control center wirelessly: 1) Sensors, thermostats. Control the parameters of temperature, pressure, humidity, motion, smoke, etc.; 2) Executive equipment – all smart devices that execute commands from remote access.

Integrated home automation can provide: wireless communication between the elements; switching on and off the equipment from a smartphone; voice commands; the ability to create your own control scenarios; video surveillance of the home and the courtyard territory of a country house. To do this, you need to provide communication between IoT devices, the control center and the owner of the house.

There are two types of connection and communication options: connection and communication between elements via wires; wireless connection and signal exchange. The first option works more reliably, the exchange of signals and reactions are faster, the components are cheaper. All components are connected by wires. The option is most suitable for an apartment and for a country house, if it is a new building or is planned to be renovated. The wireless option does not require wiring between components and installs quickly. However, its components are more expensive and their batteries require timely and frequent replacement [1, p. 3].

The implementation of home automation often begins with the adjustment of lighting and smart sockets. The light can be turned on and off by the motion sensor, and the intensity of the lighting can be adjusted by voice. To control the outlet, the owner just needs to log in to the app on his

smartphone, find and de-energize the outlet with a light touch of the screen. This is already widely applicable in 2021.

The market forIoTdevices is expanding. Soon, the ability to integrate into the home control scheme will become standard for all electrical appliances. Smart home allows the owner to configure and control not only individual devices, but also to develop "scenarios" for a set of devices in one or more rooms, for example, "Vacation" and "I'm home". Modern home automation is characterized by excellent flexibility. It can be customized exclusively to your needs. In addition to improving comfort, efficiency and safety, it improves the lives of people with disabilities.

An ecosystem is called smart home management from a central remote control or remote access. It is enough to purchase a basic kit that includes security control in case of fire, water leakage, unauthorized entry. You won't need to configure it. Other devices can be purchased and installed later.

The most popular system models: Apple Home Kit, Amazon, Google Home, Xiaomi MiHome. Not all devices fit into different ecosystems. Apple Home Kit socket, won't work with Amazon, etc. Manufacturers of household appliances, produce products specifically for Apple, Google or Amazon. When purchasing components, you should pay attention to the compatibility with your system [3, p. 3].

Smart home means safety, economical (up to 40%) energy consumption, the ability to prevent accidents on heat and water networks (within the apartment), a new level of comfort. Comprehensive automation of housing will greatly facilitate the lives of disabled people, give them the opportunity to serve themselves without assistance. To automate the house, you need to choose a system that is suitable for you and integrate it into your home.

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Аннотация. Система "Умный дом" с каждым годом становится все более популярной. Разработчики конкурируют друг с другом, предлагая покупателю новые устройства с возможностью автоматического и дистанционного управления, позволяющие сделать жизнь комфортнее, экономить электроэнергию, защитить дом от злоумышленников и предотвратить аварийные ситуации. Рассмотрены

системы автоматического управления умными домами и интегрированные технологии автоматизации. Изучен рынок интеллектуальных устройств и выявлены популярные модели систем управления.

Ключевыеслова: умный дом, информационные технологии, автоматизация, автоматизированные системы.

Annotation. The Smart Home system is becoming more and more popular every year. Developers compete with each other, offering the buyer new devices with the possibility of automatic and remote control, allowing to make life more comfortable, save energy, protect the home from intruders and prevent emergencies. Automatic control systems for smart homes and integrated automation technologies are considered. The market of smart devices has been studied and popular models of control systems have been identified.

Keywords: smart home, information technology, automation, automation systems.

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HISTORY OF THE SMART HOME SYSTEM DEVELOPMENT

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A smart home is an intelligent home management system that ensures the automatic and well-coordinated operation of all the building's security and life support systems. Such systems can independently recognize changes in the room and respond to them accordingly. The main feature of the technology is the integration of individual devices and subsystems into a single automatically controlled complex. The concept originated in the United States in the early 70s of the last century, in the "Institute of Intelligent Buildings". At that time, a smart home meant "a building that provides a productive and efficient use of the working space".

The idea to control various sensors and systems through the electrical wiring of the house appeared in the United States in 1978. Then two American companies released cable technology to the market, which became widespread within one particular country due to the possibility of

its operation only in American power grids, the developments were implemented in North America, as they were designed to operate at a voltage of 110 V and a network frequency of 60 Hz. To speed up the development of such technologies, their developers created the Electronic Industries Alliance. After that, a special standard for consumer Electronic Bus was developed, which was open, which allowed any company to use it, if its developments would meet certain rules. Since the early 2000s, the technology has become increasingly popular and spread among people.

Currently, technology has moved far ahead. The management of the house and all the elements of the extensive system is carried out using the Internet. For this purpose, smartphones and tablets are used, on which a special application is installed [1, p. 3]. Such systems are provided by several manufacturers at once, which allows you to choose a "Smart home" at an affordable price and with the necessary set of functions. The development of the technology is now taking place all over the world, and not only in individual countries that were originally members of the European association.

In Russia, the "Smart Home" technology began to be introduced only in the 2000s, due to the active development of computer technologies and telecommunications. Such a convenient and innovative solution was purchased by wealthy people — security systems, video surveillance, lighting, climate control, audio and video equipment quickly became an attribute and indicator of the status of the owner of a private "Smart home". "The requirements of Russian customers" at this stage differ from the global ones, experts of the committee of NP AVOC "Intelligent Buildings and Information Management Systems". The main goal of "smart homes" in Europe and North America is to save energy, as such systems help to significantly save water and electricity, which are the main resources for the comfortable functioning of the human home. Comfort from these systems is important, but it does not play a major role in their installation. In Russia, the main reasons for installing an intelligent system are functionality and ease of operation. There was no talk of energy saving.

System features: Lighting control. The system makes it possible to combine all devices operating in the building and outside it into a single network, which allows to control and save on electricity consumption. You can adjust the level of lighting by remote controls, push-button and touch panels, switches, devices running on Apple or Android OS; Climate control. The smart home is equipped with a climate control system that works in multitasking mode. She simultaneously manages the devices that carry out the processes of ventilation, heating and air conditioning of the building. The system is able to set the temperature for each room individually and

constantly maintain it at a given level; Control of the security system. Intelligent technologies help to protect the home from intrusion. Fire alarm devices, as well as systems that prevent accidents related to water supply damage or gas leakage, will help protect the house from accidents. In the event of an emergency power outage, the backup power saving system is activated. In case of penetration into the home, the video surveillance system and security alarm system will warn their owners and record what is happening; Multiroom. The system allows you to distribute video or sound from the signal source to the entire room; Wake up. Technology allows to make the process of awakening easier and more enjoyable. To do this, you need to create a clear scenario, according to which the technology will work; Pedagogy. "Smart Home" offers its services in the education of children. With the help of the system, parents can control the time spent by the child on the Internet by restricting access to various "harmful" devices, for example, a TV, a computer and other objects. Similarly, a Smart home can structure and discipline a child's life [1, p. 3].

The introduction of the most basic elements of the "Smart Home" only at the stage of construction of an office building or a residential building, allows you to subsequently combine the buildings into a single network. In the near future, this phenomenon will occur more often, but at the level of small areas [2, p. 3]. This means that in the future, the construction of "Smart Homes" can turn into the creation of "Smart Cities". The advantages of implementing automation, dispatching and security systems in urban life-support facilities: collection and accounting of the necessary statistical information, followed by the formation of reports for the administrative services of the city; control of engineering systems, planning of preventive and repair work, increasing the service life of equipment; monitoring and accounting for the consumption of urban resources (water, gas, electricity), increasing the efficiency of their use. Based on the experience of construction companies, the most successful and best-selling projects are homes and offices with integrated control systems. Increasingly, the buyer is interested not only in the design of the project, but also in modern systems that allow saving money [2, p. 3]. This leads to the conclusion that "Smart homes" are the future.

Smart Home technology is developing very dynamically. It is likely that in the near future such systems may relate to the basic configuration of the apartment. Thanks to this technology, the user will be able to see statistics and adjust their spending and behavior. It is also possible to supplement this complex, as various modules (light bulbs, speakers, household appliances, etc.) are actively available for sale.

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Аннотация. Рассматривается понятие «Умный дом». Раскрываются предпосылки и история создания системы. Изучена практика применения в различных странах, в том числе и в России. Выявлены различия в назначении установки устройства, его основных преимуществах и возможных функциональных особенностях. На основе анализа строительных компаний, работающих с интеллектуальными системами, сформировано представление о развитии технологий и формировании «умных» районов и городов. Изучена возможность внедрения и совершенствования системы для среднестатистического гражданина.

Ключевые слова: умный дом, информационные технологии, автоматизация, автоматизированные системы, мехатроника.

Annotation. The concept of "Smart home" is considered. The prerequisites and history of the system creation are revealed. The practice of application in various countries, including Russia, has been studied. The differences in the purpose of installation of the device, its main advantages and possible functional features are revealed. Based on the analysis of construction companies working with smart systems, an idea of the development of technology and the formation of "smart" areas and cities is formed. The possibility of implementing and improving the system for the average citizen is studied.

Keyword: smart home, information technology, automation, automation systems, mechatronics.

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RASPBERRY PI IN THE SMART HOME SYSTEM

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Raspberry Pi is a microcomputer that allows to control absolutely all electrical appliances in the house and monitor it thanks to a number of sensors. At the same time, the microcomputer has dimensions comparable to a small smartphone, and operates on the Raspbian, Pimatic and other operating systems on the Linux kernel, as well as on Windows 10. For 2021, the microcomputer is available in 8 versions. All editions differ in the amount of RAM, the model and performance characteristics of the processors used (the clock frequency is in the range from 700 to 1200 MHz, the number of computing cores - from 1 to 4), the cost and supported interfaces. The latest versions allow to connect a variety of sensors that respond to sound, heat, and movement.

The Raspberry Pi 3 is a single-chip system based on a 64-bit BCM2837 processor with four cost-effective Cortex A53 cores operating at a clock frequency of 1.2 GHz. If necessary, they are overclocked, but such situations are rarely required when building huge systems. The computer is equipped with 1 GB of RAM and Bluetooth 4.0 and Wi-Fi wireless modules. It weighs 40 grams [1, p. 3].

The smart home, which was proposed by the company Raspberry Pi, allows you to control absolutely everything in the house: from turning on the lights and heating system to activating systems that simulate the presence of a person in the house. The coordinated work of all parts of the system is based on sensors and special controllers that respond to movement, noise, and energy [2, p. 3]. The system is in demand on the market due to the fact that it can be easily assembled as a simple constructor. It can function at the same time on different cores.

The structure of the system can be different. Usually, it is built according to this principle: the main thing is the central computing device (server). The central system server is a Raspberry Pi, on which a WEB interface is installed that can communicate with a laptop, tablet, and smartphone. The server communicates with the peripheral special modules via the RS485 interface. In order for the system to work smoothly, a special controller is always installed in each key room of the household, the task of which is to interpret the incoming signals and send them to household appliances, which in this regard are performing devices [1, p. 3]. Usually, the Raspberry Pi module communicates with the controllers via the UART port. The operating system is Raspberry, which can be accompanied by the Pimatic extension. You can also build a special system on an "open platform", for example, wiButler.

The Raspberry Pi computer purchased by the user is a microcontroller, to get a smart home system, you need sensors, actuators, interfaces, and software, as shown in Figure 1. Consider the types of modules: a module for

a wireless connection - most often used receiving and transmitting devices operating at a frequency of 433MHz; a motion sensor-used to execute commands when there is movement in the area of its action, for example, turning on and off lighting; a temperature sensor for taking temperature indicators in a room or premises; humidity sensor is needed to expand the functionality of the weather station, there are options for combining temperature and humidity sensors in one device; smoke sensor-is needed to get information about the appearance of smoke or fires; camera can be used to create a video surveillance system, records video in resolution up to Full HD and can take pictures under specified conditions. Available options with an infrared emitter; fire alarm system-consists of sensors for water leakage, smoke, video surveillance, depending on the wishes of the buyer; Homematic is a popular Smart Home system that supports integration into Raspberry [2, p. 3].
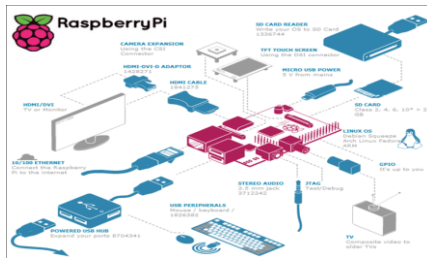
Figure 1 – The Raspberry Pi computer

For a person who wants to make their life more comfortable and safer, the Raspberry Pi 3 Smart Home system is a reasonable solution. However, it is worth paying attention to the advantages and disadvantages of the device to form a complete picture.

Advantages: after installing the special system "Smart Home" housing becomes protected from most problems. The system allows you to protect your country house, cottage or dacha from fire, water leaks and even theft; with the correct installation of a sensor that responds to movement, the amount of electricity consumed is significantly reduced, because the light turns off automatically if a person is not in the room. You will have to pay much less for utility bills; reducing the consumption of electricity for heating the premises. You can turn on the batteries remotely for 1-2 hours, depending on the area, before arriving home. It is also possible to turn off the heating remotely if the user has forgotten to do so; increasing the comfort level and saving time. For example, you can turn on any device while in another room; intelligent entertainment systems — a "home theater" or a multiroomsystem. Despite the large number of advantages that

this system has, there are several disadvantages. They need to be taken into account. A smart home based on raspberry pi has the following disadvantages: it is not rational to purchase a system for a small apartment; for proper functioning, you need to understand every element of the work or find a person who can help if some mechanism fails; some components may eventually disappear from sales, because technologies do not stand still, but develop very quickly.

Despite several disadvantages, the significant advantages of this system overlap them. Raspberry Pi smart home is a device that copes with a large number of tasks, offering several optimal solutions. You can buy ready-made kits or develop everything yourself.

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Аннотация. Исследован микрокомпьютер RaspberryPi, рассмотрены основные параметры и функции. Более подробно рассказывается о третьем поколении микрокомпьютера и его особенностях, обусловленных его популярностью для создания современной умной системы. Описана структура формирования умного дома на базе RaspberryPi. Рассмотрены модули, подключаемые к микрокомпьютеру для создания и дополнения системы. Проанализированы преимущества и недостатки системы умного дома RaspberryPi. Сделаны выводы об удобстве использования и возможности совершенствования системы.

Ключевые слова: умный дом, информационные технологии, автоматизация, автоматизированные системы, raspberrypi.

Annotation. The Raspberry Pi microcomputer is studied, the main parameters and functions are considered. More details are given about the third generation of the microcomputer and its features, due to its popularity for creating a modern smart system. The structure of the formation of a smart home based on Raspberry Pi is described. The modules that are connected to a microcomputer to create and supplement the system are considered. The advantages and disadvantages of the Raspberry Pi smart home system are analyzed. Conclusions are drawn about the ease of use and the possibility of improving the system.

Keywords: smart home, information technology, automation, automation systems, raspberry pi.

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ANALYSIS OF THE IMPACT OF DENORMALIZATION OF RELATIONS ON THE EXECUTION TIME OF A QUERY TO A RELATIONAL DATABASE IN VARIOUS ENVIRONMENTS

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Introduction

Fast retrieval of information from the database is often not possible due to large amounts of data and queries that contain access to a large number of tables. Therefore, the creation and application of methods that reduce query execution time is an actively developing area of research. In large databases, the issue of reducing data access time is most acute, since the execution time of some queries has a significant impact on the response time of the entire system. Such requests are called critical requests. These are often queries that contain multiple table join operations. Their execution time should not exceed the allowed values. To achieve this goal, a number of methods have been developed based on query optimization [3], index optimization [4], the use of materialized representations [5], and denormalization [6]. Oracle has developed a powerful tool (ADDM) for collecting statistics, analysis, and recommendations for database optimization [2]. It allows to optimize queries, indexes, and also fix database downtime or the time when tables are unavailable. However, this tool does not give recommendations about denormalization, since this mechanism contradicts the rules for building a database model. In this regard, it is proposed to develop a solution for determining the order of denormalization and evaluate the effectiveness of the method depending on the DBMS.

Main part

In this paper, we investigated the effectiveness of applying denormalization to queries containing five relations and four join operations. For the correct operation of the algorithm for determining the order of denormalization, the request must be presented in a processed form – associative arrays, lists. It is proposed to automate the process of building the structure of an SQL query. This will avoid pre-preparing the necessary data manually. All methods of analyzing SQL queries consist in its division into elements-tokens. This process is called tokenization. During the

tokenization process, the type of the request is determined (SELECT, DELETE, UPDATE, etc.), keywords, names of relations and attributes are highlighted.

The query parsing algorithm consists of 4 stages. The first stage is preprocessing the sql code: removing insignificant tokens. This is followed by extracting the tables used in the query, defining the attributes extracted using the SELECT keyword, and defining the dependencies between the tables. Figure 1 shows the general scheme of the algorithm.
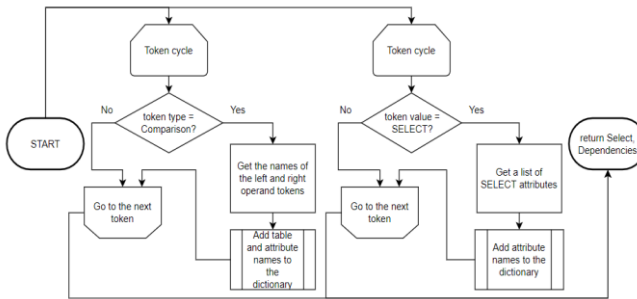
Figure 1 – General scheme of the sql query analyzer algorithm

The resulting request structure is fed to the algorithm for determining the order of denormalization, which in turn consists of three stages:

1. Selection of relation pairs suitable for denormalization;

2. Determining the feasibility of denormalization-calculating the value at which there will be an increase in performance and, as a result, a decrease in the execution time of the sqlquery;

3. Updates to the database table structure.

At the first stage, Dependencies alternately considers the relationship pairs: parent relationship – child relationship. Determines whether the child relationship is the parent of some other relationship pair and whether the parent relationship is the parent of some other relationship pair. In both cases, in the case of a positive result, this pair of relations is not considered further, since such cases would greatly complicate the calculations. In the case of a negative result, an algorithm is performed to determine the feasibility of denormalization.

In most cases, all tuples of tables are stored in more than one block of memory. Therefore, only such tables have been considered in this paper. To determine whether it is appropriate, the new size of the child relation tuple is calculated: the tuple obtained by adding the parent relation attribute to the

child. The size of the new tuple is compared with its original size, multiplied by a factor:

$$h^{'} < n\frac{1+m}{m}h,$$ (1)

where $h^{'}$ is the size of the new tuple of the child relation, n is the number of blocks in which the parent relation is placed, m is the number of blocks in which the child relation is placed, and h is the size of the original tuple of the child relation. If the condition is met, denormalization will reduce the query execution time [1].

At the third stage, the dictionaries containing information about the query and database tables are updated in accordance with the results obtained at the previous stage. If it was found out that duplicating an attribute in a child relation will reduce the query execution time, the structure of the child relation and the table structure are updated accordingly: a new attribute is added to the child relation, the average size of the tuple is recalculated, and one join operation is deleted in the query.

Since the DB model is updated dynamically, the DB structure transformation algorithm can be performed iteratively, reducing the number of join operations at each subsequent iteration as long as possible.

The experiment was performed with a different number of tuples in the parent relation: 20,000, 40,000, and 60,000 units. The results were averaged over 10 experiments in Oracle DB, PostgreSQL, and MySQL.

Table 1. The dependence of the query execution time on the number of tuples of relations

DBMS / Number of tuples	Oracle		PostgreSQL		MySQL	
	Norm	Denorm	Norm	Denorm	Norm	Denorm
20000	31ms	24ms	43ms	25ms	387ms	161ms
40000	46ms	36ms	57ms	35ms	437ms	221ms
60000	57ms	45ms	79ms	48ms	480ms	269ms

Using denormalization of one of the relations allowed to reduce the query execution time. However, do not forget that in the case of using this method, the integrity of the data is violated and there is a need to monitor the compliance of the same data in different respects. To do this, you can use the built-in database mechanisms: for example, triggers.

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Аннотация. В настоящей статье приведены основные методы повышения производительности баз данных. Разработан алгоритм определения порядка реструктуризации отношений в зависимости от структуры SQL запроса и характеристик базы данных. Исследовано влияние метода денормализации на время выполнения критических запросов в различных системах управления баз данных.

Ключевые слова: реляционная база данных, денормализация, SQL-запрос, критические запросы, реляционная алгебра, производительность БД, СУБД

Annotation. This article describes the main methods for improving database performance. An algorithm is developed for determining the order of relationship restructuring depending on the structure of the SQL query and the characteristics of the database. The influence of the denormalization method on the execution time of critical queries in various database management systems is investigated.

Keywords: relational database, denormalization, SQL query, critical queries, relational algebra, DB performance, DBMS

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RESEARCH OF METHODS FOR CONSTRUCTING DIGITAL TERRAIN MODELS

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Introduction. Building a digital terrain model (DTM) based on satellite images is one of the most important tasks in systems for processing and analyzing remote sensing data (RSD). Therefore, the software

components for building a DTM are present in most commercial remote sensing data processing software systems. The most popular among them are ENVI, PHOTOMOD, and Geomatica [3-5]. However, there is a problem with the efficiency of building terrain models. Space images tend to be large sizes that are subject to processing problems related to both memory and processing power constraints. Therefore, users are forced to "cut" fragments of relatively small sizes from the source images and build local models of the terrain.

An important requirement is to solve this problem in real time, for example, to monitor emergency situations, to analyze the background-target situation, to plot routes, etc. Therefore, to increase the efficiency of the construction DTM, the use of high-performance technologies, such as MPI, is relevant, Open MP, including on GPUs using CUDA technology [2].

In this article, we describe, to a large extent, the traditional technology of constructing a DTM based on remote sensing data [1], as well as a detailed description of its mainstages. At the same time, the main attention will be paid to the description of the distinctive features of the implementation of these stages, in comparison with the known ones, as well as to the analysis of the degree of internal parallelism. Taking into account this analysis, a hybrid implementation of the end-to-end technology for constructing DTM based on space images is proposed.

Parallel image matching algorithm. The parallel implementation of the algorithm for constructing a disparity map from pairs of rectified images using the CPU and GPU is illustrated in Figure 1. The interaction of the CPU and GPU is represented as the interaction of three blocks.The first and third blocks include procedures that run only on the CPU. The results of the procedures in the first and third blocks are used in the second block to run the CUDA core on the GPU.
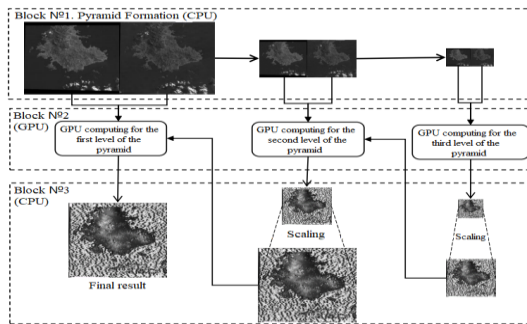
Figure 1 – The scheme of interaction of CPU/GPU on the example of three levels of the pyramid

In the first block, a pyramid of images is formed for subsequent image matching. For clarity, Figure 2 shows a three-level image pyramid (Block №1) for a pair of rectified images. The image pyramid is formed as a set of images obtained by reducing the resolution by half at both coordinates.
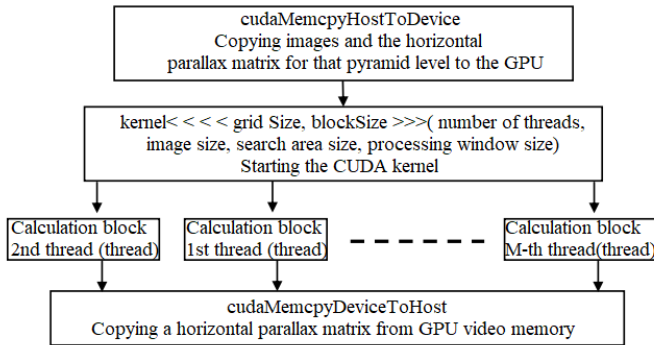
Figure 2 – GPU computing block

Figure 3 shows an enlarged diagram of the calculations performed by a single thread. This calculation block in Figure 2 is designated as the "Thread Calculation Block".
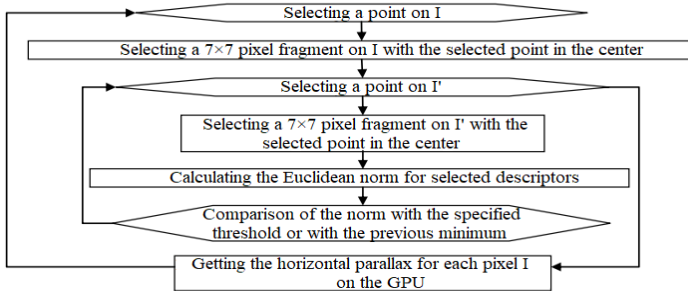
Figure 3 – Diagram of the calculations performed by a single thread when running the CUDA kernel

Creating a three-dimensional model. After matching, a point in three-dimensional space can be calculated for each pair of corresponding points. To do this, you can use the method described in the article.

$$\begin{cases} Y_L = \dfrac{a_L^T u}{b_L^T u} \\ X_L = \dfrac{c_R^T u}{d_R^T u} \\ Y_R = \dfrac{a_R^T u}{b_R^T u} \\ X_R = \dfrac{c_R^T u}{d_R^T u} \end{cases}$$ where L, R are the left and right images.

Experimental results. Stereo pairs obtained from the IRS-P5 spacecraft with a spatial resolution in the nadir of 2.5 meters were selected as the initial data. The IRS-P5 stereo pair (Cartosat-1) was received on January 30, 2008.

The original images are shown in Figure 4.

a) left source image   *б)* right source image
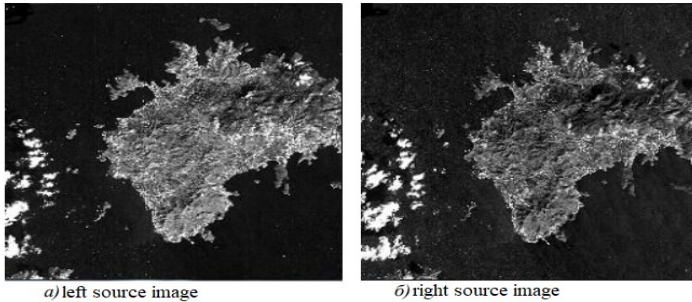
Figure 4 – Source images

A three-dimensional model was constructed based on the ENVI matching algorithm. The resulting model (Fig. 5, a) clearly shows the mountains and terrain. Obviously, the surface of the water is not restored correctly. Figure 5, b shows the disparity map generated using the proposed hybrid CPU / GPU technology.

a) ENVI   *б)* CPU/GPU implementation
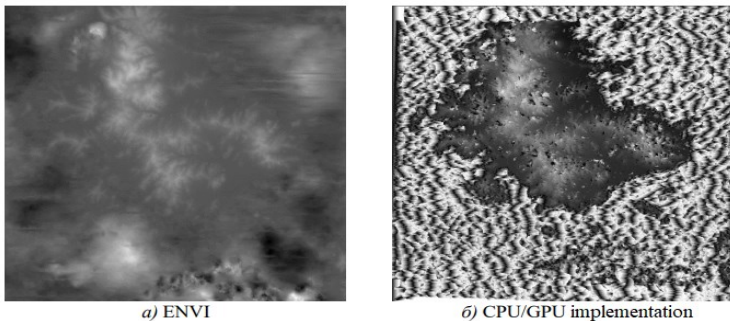
Figure 5 – ENVY and the developed parallel algorithm
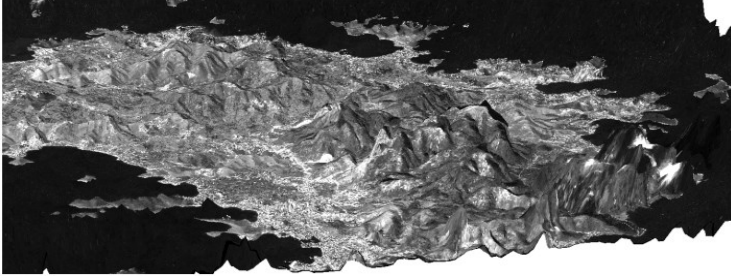
Figure 6 – 3D visualization

Figure 6 shows a three-dimensional model of the terrain obtained from the result of image comparison.

Table 1. The results of the study

Pyramid Level (image resolution in pixels)	1 219× 219	2 438× 438	3 875× 875	4 1750× 1750	5 3500× 35000	6 60000× 6000	7 12000× 12000
Lead time ENVI (milliseconds)	$1.1*10^3$	$1.87*10^3$	$7.44*10^3$	$28.24*10^3$	$12.54*10^3$	$41.27*10^3$	$806.5*10^3$
Lead time CPU / GPU technology (milliseconds)	-	6.3	20.2	70.4	252.9	925.3	3390

Conclusion. The results of the experiments show that the developed end-to-end technology provides the quality of a three-dimensional digital terrain model comparable to the quality achieved using the ENVI-5.0 software package. Implementations of the technology when processing the same pair of images with dimensions of 12000×12000 are 532 times smaller. Unfortunately, there are currently no representative databases of test sets of three-dimensional models and corresponding multi-angle images.

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Аннотация. В работе исследуется технология построения цифровой модели местности (ЦММ) попоследовательности космических снимков. Технология строится на базеразработанных авторами ранее быстро действующих алгоритмов сопоставления изображений и построения карт диспарантности, реализованных на графических процессорах. В настоящей работе сформирована сквозная технология построения ЦММ по последовательности разноракурсных космических изображений.

Ключевые слова: цифровая обработка изображений, разноракурсные изображения, реконструкция 3D-сцен, сопоставление изображений, CUDA-технология, ENVI.

Annotation. This paper considers the technology of digital terrain model (DTM) generating using a sequence of satellite images. The technology is built on the basis of algorithms for image matching and disparity maps generating previously developed by the authors and implemented on GPUs. This paper presents a general technology for the DTM construction from a sequence of satellite stereo images..

Keywords: digital image processing, 3D-scene reconstruction, image matching, CUDA.

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THE ACCESS CONTROL SYSTEM FOR ROOM

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Introduction. Ensuring the safety, security of information and monitoring the effectiveness of employees, monitoring visitors to the organization is a significant and relevant task today.

To date, in the premises of any organization, such methods of identification of persons as a paper or electronic (RFID) pass, passport, driver's license are used for access. In developed infrastructures, electronic RFID passes for employees are used.

At the same time, any person can enter the room using the employee's working electronic pass. This is not the most reliable method of identifying a person.

In this paper, it is proposed to strengthen the security of the object (room) by using computer vision technology. Computer vision technology allows you to create a counter of passing people on the object, as well as to recognize the identity by comparing the data obtained with the data stored in the database.

Computer vision technology will allow to get rid of turnstiles and the presence of electronic passes for visitors, especially if it is a store, bank or other object where all citizens can pass, not only employees who have an electronic pass.

The proposed system performs identity recognition based on the video stream from the camera located at the entrance to the room. Turnstiles may or may not be present in this room, depending on the purpose of the object.

The aim of the article is to present the development of an improved control and management system for room access using artificial intelligence.

Main part. In the proposed system for monitoring and controlling access to the room, the main sensor is a video camera.

Preference is given to a digital video camera, since the image is more accurate, which improves the ability to identify a person from the video stream. Figure 1 shows an example of an image taken from a 960H analog camera and a 720p digital camera.

Figure 1 — Images taken from an analog camera (left) and a digital (right) camera

The meaning of computer vision, as mentioned in the previous sections of this paper, is the ability of a personal computer (PC) to recognize and determine the essence of the image. This is the most important area in artificial intelligence, which includes several actions at once:

– Recognition of the content of a photo;

– Definition of the subject and its classification or generation.

For software development, you need to connect libraries (frameworks) to Python: OpenCV, Image all, Numpy, SciPy, Pillow, Matplotlib, H5py, Keras.

ImageAI has support for a lot of different settings for searching for objects. For example, you can configure the extraction of all found objects during image processing. The search class is able to create a separate folder named image, and then extract, save, and return an array with the path to all objects.The main branch of computer vision is the extraction of information from images or sequences of images. One of the tasks solved in this section is to determine the object of interest. There are many possible solutions to this problem: the search for contours, the search for descriptors and singular points, the use of neural networks, etc.

A better and more accurate method is the Canny detector. Canny developed a boundary detector that is optimal for three criteria: low error rate, correct localization, and minimizing responses to a single boundary.

In a more detailed sense, this means that the detector should not detect false boundaries (for example, for noise), should correctly and not fragmentarily determine the boundary line, and only respond once to each boundary to avoid the appearance of wide bands. The Canny detector algorithm consists of 5 steps.

The first step is smoothing. It is used when you need to reduce the amount of noise to avoid false borders. For this purpose, blurring is often used with a Gaussian filter or some kind of matrix blur filter [3]. The next two steps are finding gradients and suppressing non-maxima. To begin with, all the brightness gradients are found, for this you can use, for example, the Sobel operator described above, but in order for the border to be clear and understandable, it must be represented by a thin line [5].

And the last steps are double threshold filtering and ambiguity area tracing. At this step, another false border filtering is performed.

The Canny boundary detector uses two thresholds: a lower threshold and an upper threshold. A pixel whose value is higher than the upper limit takes the maximum value, the contour is considered valid. If the pixel value does not reach the lower threshold, the pixel is suppressed. If its value falls within the range between the thresholds, then it takes the average value, and the decision about whether it is a boundary point will be made during the ambiguity region trace [1]. The tracing task is reduced to the distribution of pixels that received the average value. If such a pixel touches a valid contour, then its value is equal

to the maximum value and it becomes part of the border, otherwise it is suppressed. In OpenCV 3. x and higher, there is a built — in function for Canny filtering (Mat src, Mat dst, int low Threshold, int high Threshold, int kernelSize). Where src is the input black-and-white image, dst is the output binarized image with the found boundaries, low Threshold and high Threshold are the lower and upper thresholds, and kernelSize is the size of the Sobel matri (fig. 2).

Figure 2 — The result of the Kenny filter

An interesting variety of boundary detectors are angle detectors. There are three categories of angle detectors: those that extract information directly from the pixel intensity of an image, methods based on determining the contour of an image, and those that use models with intensity as parameters. Defining an object using cascading classifiers Cascading classifiers [4, 7].

Cascading is a special case of ensemble learning based on combining multiple classifiers, using all the information collected from the output of a given classifier as additional information for the next classifier in the cascade. Unlike voting or stacking ensembles, which are multi-expert systems, cascading is multi-stage. Cascade classifiers are trained with several hundred "positive" samples of individual objects and arbitrary "negative" images of the same size. After training the classifier, you can apply it to the image area and determine the object in question. To search for an object in the entire frame, the search box moves around the entire image with some overlap. This process is most commonly used in image processing to detect and track objects, primarily for face detection and recognition (fig. 3).

Figure 3 — The process of facial recognition using neural networks compiled in Python

Ensemble methods are a set of weak classifiers (a weak classifier means that its error on training a sample is less than 50 %, but more than 0 %). By combining their predictions, it is possible to achieve a higher accuracy of classification of objects from the test sample [5, 6]. Implementation of the Haar cascade using OpenCV technology. OpenCV already contains many pre-prepared classifiers for face recognition (fig. 4).

Figure 4 — The process of face recognition by decomposing an image into a matrix and searching for singular points

Conclusion. Thus, the proposed system increases the throughput, due to fast methods of identifying persons, security of access to the room, flexibility in setting up options for the checkpoint or counting visitors to the room.

The disadvantage is that it requires the use of computing power, which leads to a slight, but increased cost of the system.

In further studies, the system will be implemented as a model for experimental adjustment of the algorithm and methods for identifying faces through computer vision, to confirm theoretical studies.

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Аннотация. В статье описывается актуальность и перспективы внедрения компьютерного видения в систему контроля и управление доступом в пространство с интеграцией искусственного интеллекта. Теория раскрывает преимущества системы. В дальнейших исследованиях реализуется модель для уточнения теоретических данных практического эксперимента.

Ключевые слова: контроль доступа, компьютерное зрение, искусственный интеллект.

Annotation. The article describes the relevance and prospects of the introduction of computer vision in the system of control and management of access to the room with the integration of artificial intelligence. The theory reveals the advantages of the system. In further studies, a model is implemented to refine the theoretical data on a practical experiment.

Keywords: access control, computer vision, artificial intelligence.

DETERMINATION OF THE FUNCTIONAL STABILITY OF SATELLITE NAVIGATION SYSTEMS

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1. Introduction

Successful accomplishment of logistics tasks by sea transport and efficiency of its functioning depends on the ability to make regular and safe (from the point of view of navigation) day-and-night sea voyages underall meteorological conditions. At the same time, they must maintain aspecified route and arrive at the destinationon schedule.

Nowadays sea vessels are equipped with modern navigation aids, both autonomous and non-autonomous. Obviously, global navigation satellite systems (GNSS) play a crucial role.

Their successful application is attributed to the fact that they can operate day and night under any meteorological conditions while ensuring high accuracy in gathering the data required for navigation. Also, domestic GNSS "GLONASS" is capable ofreceiving necessary measurement data anywhere in the world ocean.

Based on the above, the degree of functional stability of GNSS becomes critical especially now that the Russian Federation is oppressed by sanctionsand a possibility exists of unauthorized negative intervening with various segments of GNSS. However, at this point there is no common approach on how to define such term as functional stability.

In this paper, we propose one of the ways to assess functional stability of GNSS.

2. Main part

Main segments of GNSS areground-based automated control system (GBACS), group of navigation spacecrafts (GNS), ground-based means of differential correction of ephemeris-time information (ETI), sea vessels equipped with consumer navigation equipment (CNE) [2]. Main GNSS segments are shown in Fig. 1.
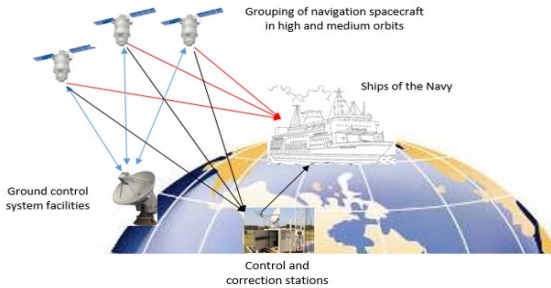
Figure 1 – The main GNSS segments

During preparation and planning for the use of GNSS in solving the particular tasks by the sea vessels, it is necessary to perform not only a qualitative, but also a quantitative assessment of their functional stability and to check it for compliance with the specified requirements. There is no doubt that the functional stability of GNSS should be evaluated as part of systematic structural analysis of the functional stability of its individual components.

Initial data for the assessment is information about the state of the GNSS segments, their technical condition, possible negative intervening, degree of protection of GNSS systems, and application conditions.

In general, the procedure for assessing functional stability can be presented as shown in Fig. 2.
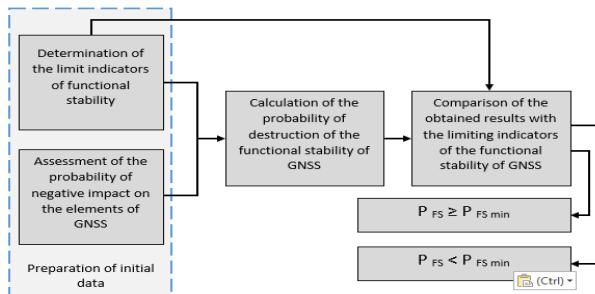
Figure 2 – The procedure for assessing functional stability

Probability P_{DA} of the destruction of the GNSS ground support complex (i.e. bringing it to a state where it cannot operate as intended) can be defined as [3]

$$P_{DA} = \prod_{i=1}^{N} P_{RPD},$$

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where, N — number of ground-based radio systems (RS) of GNSS performing similar functions that need to be disabled to disrupt the intended operations;

P_{RPD}—required probability of destruction ofthe i-th RS of the ground-based radio complex.

At the same time, the ground-based radiocomplex (RC) can be considered as operational after being hit by weapons if at least one of the components in each group of the same type components (G_i) keeps functioning, that is,

$$P_o(G_i) = 1 - \prod_{j=1}^{k} P_{DA}(A_j)\text{i},$$

where, $P_o(G_i)$ —probability of functioning of group $G_i$of RC after being hit;

k —number of elements in the *i-th* group;

$P_{DA}(A_j)$ —probability of destruction of the *j-th* element included in the *i-th* group.

Therefore, probability P_{REC} of staying operational (thus ensuring functional stability) of the ground-based radio complex of GNSS can be defined as

$$P_{REC} = \prod_{i=1}^{l} P_o(G_i)K_{OR},$$

where, l — number of functionally connected groups of RC's components;

K_{OR}— operating availability factor.

In addition to assessing the functional stability of ground-based systems of GNSS, it is necessary to perform similar assessment of the orbital group (OG) of GNSS spacecrafts (SC). To estimate it in the first approximation it is sufficient to determine the probability P_{og} of OGSC staying intact, which would ensure the required accuracy of determining the navigation parameters under predicted conditions, that is, P_{og} at T is greater than or equal to T_0. In our case, $T_0$is a required accuracy of determining the navigation parameters. In general, it can be noted that

$$P_{og} = f(V, t) \text{by } T \geq T_0,$$

where, V—control action that ensures maximum value of P_{og};

t— operating time of OGSC.

Probability of keeping the i-th spacecraft intact in the GNSS group can be calculated by determining the probability of it being hit (destroyed). It is obvious that in order to attack a spacecraft it is necessary to detect it, determine parameters of its orbit, perform recognition, and target the means of destruction. In this case, probability P_{de} of destroying the i-th SC of GNSSOG can be calculated as

$$P_{dei} = P_{dti} \times P_{reci} \times P_{asi} \times P_{defi},$$

where, P_{dtI} — probability of detection of the i-th SC of GNSSOG;

P_{recI} —probability of recognition of the i-th SC of GNSSOG;

P_{asI} —probability of targeting of space weapons for i-th SC of GNSSOG;

P_{defI} —probability of destruction of the i-th SC of GNSSOG.

Parameters in the right part of the formula are calculated using expressions from [2].

3.Conclusion

Obtaining quantitative parameters of functional stability is a required, but not sufficient, condition for the overall assessment. At the same time, using calculated values of the parameters, and having the appropriate criteria for its evaluation, it is possible to make informed decisions aimed at its improvement. By evaluation criteria we mean the conditions under which the necessary decisions will be made. These conditions should reflect the requirements essential for functional stability.

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Аннотация. Глобальные навигационные спутниковые системы (ГНСС) играют важнейшую роль в выполнении логистических задач морским флотом. Эффективность функционирования флота зависят от возможности совершать регулярные и безопасные (с точки зрения судовождения) морские рейсы в любой метеорологической обстановке, днем и ночью. При этом они должны выдерживать заданный маршрут движения, прибывать в заданный пункт в установленное время. Учитывая, что ГНСС в этом плане играют ключевую роль, актуальной представляется задача оценки функциональной устойчивости самих спутниковых навигационных систем. Точная оценка функциональной устойчивости ГНСС на этапе подготовки к решению логистических задач является одним из необходимых условий успешного достижении намеченных целей морским флотом.

Ключевые слова: функциональная устойчивость, глобальная навигационная спутниковая система, комплекс наземного обеспечения,

навигационная аппаратура потребителя, навигационный космический аппарат, орбитальная группировка.

Annotation. Global navigation satellite systems (GNSS) play a critical role in the fulfillment of logistics tasks performed by the sea vessels. Efficiency of their functioning depends on the ability to make regular and safe (from the point of view of navigation) day-and-night sea voyages underall meteorological conditions. At the same time, they must maintain aspecified route and arrive at the destinationon schedule. Given the fact that GNSS are of primary importance in this regard, the task of assessing the functional stability of the satellite navigation systems themselves is relevant. An accurate assessment of the functional stability of GNSS while preparing for solving logistics tasks is one of the necessary conditions for the successful achievement of the intended goals by the sea vessels.

Keywords: functional stability, global navigation satellite system, ground support system, consumer navigation equipment, navigation spacecraft, orbital group.

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BUILDING A SEARCH ALGORITHM
FAILURES BY MINIMUM TIME CRITERION

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In the general case, a troubleshooting algorithm is understood as a sequence of checks designed to determine a failed structural unit, that is, the identification problem is being solved [2]. If all checks make it possible to identify any possible defect, then it is considered that the problem of complete identification is being solved, otherwise we are talking about the problem of incomplete identification.

The troubleshooting algorithm can provide for a complete check of all structure elements of a technical object or, if a defect is found in any element, the search can be stopped, i.e, the troubleshooting algorithm can be unconditional or conditional.

The most significant parameters for troubleshooting are the conditional probabilities of failures (p_i) and the time to search for failures (t_i).

The conditional probability of failures occurrence p_i is understood as the probability that the failure occurred in the i-structural element of the failed technical object. In other words, the object has already failed, and with probability p_i the failure has occurred in the i-structural element. The failure search time t_i is the time of defect localization in the i-structural element.

Knowing the initial data p_i and t_i, according to statistics collected in a unified information environment, at the first stage of constructing a troubleshooting algorithm, a diagnostic model of a technical object or a table of faults is drawn up [2].

The diagnostic model shows the nature of the internal relationships in the object of malfunctions finding, as well as the possibility of failures propagation within the object.

Admit that a technical object has a diagnostic model shown in figure 1. The device has two inputs and one output. The model distinguishes 8 structural units X_i, interconnected each of which fails with probability $p(x_i)$.
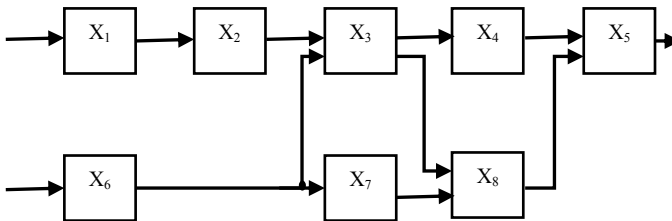
Figure 1 – Functional diagram of the diagnostic model

To assess the correct functioning of a technical object, a number of checks y_i are provided (the check number corresponds to the number of the diagnosed structural unit X_i). Relationships of elements in the diagnostic model allow to determine the "scope" of the check y_i: for example, checking an element in which the inputs are outputs of other elements at the same time provides verification of these elements as well.

The second step is composing a table of dimension 8 * 8 faults (according to the number of failures and checks), where the rows contain the checks y_i, and the columns - the failures x_i. If the check y_i reveals a defect in the structural unit X_i, then at the intersection of the corresponding row and column we put the symbol "1", otherwise - "0". If the statistical information on failures is known, then a column and a row are additionally entered in the failure table. Data on the time spent on the i-check is recorded in the column, and data on the conditional probabilities of failure of the j-structural unit of the technical object provided that the system has failed, and there is statistics

about the failure of this element during the check, is recorded on the line. In the variantconsidered, we randomly fill in the lines of statistical data about the technical object (in practice, the operating experience is used, generalized in a unified information environment) – obtain Table 1 – a table of malfunctions (matrix, questionnaire, etc.).

When constructing a troubleshooting algorithm, the information determined by each check $y_i$is detected. Priority is given to the check that gives the maximum average information about the object after the check. The informational approach does not take into account the time spent on each check.

To eliminate this gap, E.Y.Barzilovich [1] proposed to introduce a complex coefficient to assess the effectiveness of verification:

$$\gamma_i = \frac{I_i}{t_i} \qquad (1)$$

where t_i is the defect search time.

Table. 1 Initial table of malfunctions

Check	Structuralunits								t_i
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	
Y_1	1	0	0	0	0	0	0	0	1
Y_2	1	1	0	0	0	0	0	0	2
Y_3	1	1	1	0	0	1	0	0	3
Y_4	1	1	1	1	0	1	0	0	2
Y_5	1	1	1	1	1	1	1	1	3
Y_6	0	0	0	0	0	1	0	0	2
Y_7	0	0	0	0	0	1	1	0	1
Y_8	1	1	1	0	0	1	1	1	4
p_i	0,075	0,2	0,1	0,075	0,1	0,15	0,05	0,25	1

The check that has the maximum value of the efficiency coefficient γ_i is done first of all.

A troubleshooting algorithm for the object shown in Figure 1 using the information method may be constructed. Table 1 contains all the initial data for the calculation. It needs to be extended by introducing columns I_i and γ_i.

After performing calculations according to formulas (1) and (3) [3], we obtain table 2.

Table 2. Table of malfunctions with calculated I_i and γ_i.

Check	Structural units								t_i	I_i	γ_i
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8			
Y_1	1	0	0	0	0	0	0	0	1	0,132	0,132
Y_2	1	1	0	0	0	0	0	0	2	0,274	0,137

Y_3	1	1	1	0	0	1	0	0	3	0,544	0,181
Y_4	1	1	1	1	0	1	0	0	2	0,676	0,338
Y_5	1	1	1	1	1	1	1	1	3	0,9210	0,307
Y_6	0	0	0	0	0	1	0	0	2	0,137	0,069
Y_7	0	0	0	0	0	1	1	0	1	0,268	0,268
Y_8	1	1	1	0	0	1	1	1	4	0,824	0,206
p_i	0,075	0,2	0,1	0,075	0,1	0,15	0,05	0,25			

Further, those rows in which there are only 1 or 0, as well as columns corresponding to these rows, are deleted from the table. After that, the first check for the maximum value of the efficiency coefficient γ_i is selected.

Analisis of table 2 allows to conclude that check y_4 should be carried outas the first check, since it has the maximum efficiency. If, all defects are split into multi-element subsetswhen choosing a check, then different tables are built for each of the subsets. Next, we break each of the resulting tables according to the same principle. The general algorithm for troubleshooting using the information method is shown in figure 2.
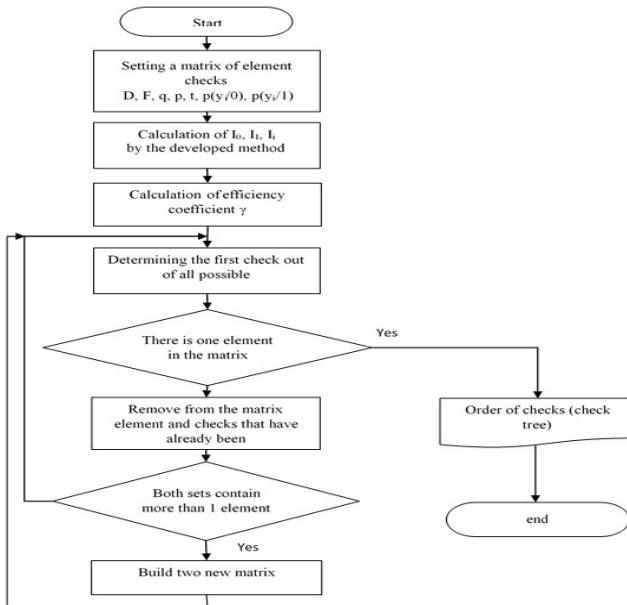
Figure 2 – Algorithm of troubleshooting with information method use

The result of the construction is the troubleshooting tree graph shown in figure 3.
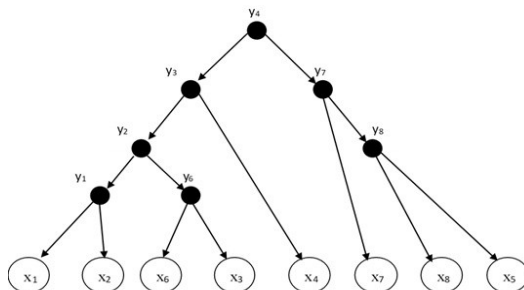
Figure 3 – Tree graph of troubleshooting

The described information approach to the construction of diagnostic algorithms for technical systems allows to minimize the number of checks of elements for various stages of their life cycle and to build an optimal diagnostic algorithm taking into account the deterioration of the system reliability as a whole. In contrast to the known ones, the proposed approach allows to synthesize optimal diagnostic algorithms taking into account errors such as false failure and incorrect detection of failure, as well as taking into account statistical information on systems of the same type.

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Аннотация. В статье представлен вариант решения задачи поиска и устранения неисправностей технической системы на различных этапах ее работы с использованием информационного подхода, который в отличие от известных позволяет учитывать как статистическую информацию об отказах составных элементов системы, так и ложный отказ продукта в целом.

Ключевые слова: устранение неисправностей, поиск, информационный подход, алгоритм диагностики, техническая система, таблица неисправностей.

Annotation. A variant of solving a technical system troubleshooting problem for various stages of its operation using an information approach is given in the article.Unlike the known ones, it allows taking into account both statistical information about the failures of the system constituent elements, and the false failure of the product as a whole.

Keywords: troubleshooting, finding, information approach, diagnostic algorithm, the technical system, the table of malfunctions.

UDC 004.
HAUSDOFF DISTANCE AND METHODS OF OPTIMIZATION

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One of the well-known methods for detecting and analyzing objects in binary contour images that are distinguished from the surrounding context by their geometric properties is the geometric measurement of the distance between the image points. One approach to solving this problem is to modify the Hausdorff metrics to identify objects that are geometrically close to arbitrary reference ones specified by bit masks. In this approach, an image is considered as a set of complex elements or a set of points in a two-dimensional Euclidean space [1].

The objectives of the study are to optimize the Hausdorff distance, determine the Hausdorff distance, and find ways to reduce this distance. The biggest disadvantage of algorithms that use Hausdorff modifications of the Hausdorff metric is the rather high computational complexity, on average 2 ~ 2-3 times higher than that of the simplest correlation algorithms. Non-invariance to rotation and scale, which, in the absence of a priori information about the orientation and size of objects to be recognized objects, forces us to use scanning of many variants of the standard sample at different rotation

angles and scales, so one of the urgent problems is the development of a technology for optimizing the calculation in this algorithm.

If S is a closed subset of the two-dimensional plane R^2 and x a point in R^2, the distance between x and set S is defined as:

$$dist\ (x,\ S) = min\ |x-y|.$$

Extending this notion to the distance between two closed subsets S_1, S_2 of R^2, we get the Hausdorff distance:

$$d_H\ (S_1,\ S_2) = max\ max\ min|x_1-x_2|, max\ min|x_1-x_2|.$$

$$x_2 \in\ S_2 x_1 \in\ S_1$$

These notions have been used in computable analysis to study closed subset of two dimentional plane. For example, Brattka and Weihrauch [4] showed that for several formulations of computable closed sets in R2, the distance function δS (x) dist (x,S) of a computable set S is a computable function. Braverman and Yampolsky [2] applied these notions to study the computability of Juliasets.

Thus, the problem of finding the minimum point x* reduces to a complete search among a finite number of options. The pairs of vertices of different polygons give type V vectors of type V, and the pair wise consideration of the vertices of the same polygon with the sides of the other gives type W vectors of type W. In the auxiliary space it is required each time to solve the problem of the optimal placement of the point x* that provides the smallest distances to the corresponding points and lines. In other words, in each case, you need to find the center of the circle passing through the given points and tangent to the given straight lines.

Based on the described work, an algorithm was implemented that, by completely searching among a finite number of options, depending on the number of vertices of the given polygons, finds an exact analytical solution to the optimization problem.

One of the important drawbacks of the described algorithm is the need for a complete search, which leads to very high computational complexity. But, despite these shortcomings, the algorithm provides finding the exact solution in a fixed time.

The implementation of this algorithm was divided into several logical parts. The first part was the creation of data structures, both to store polyhedra, and to optimize the results at each step of the algorithm, as well as to enable storing and reading data structures from the file. The second part includes all the auxiliary algorithms that perform the following operations: finding vectors from the vertex of one polygon to the other, checking algorithms, whether this vertex-vertex and vertex-side pair of vectors (in both directions) ensures the best optimization. Similarly, the checks for a triple of vectors from the set of vertex-vertex and vertex-side pairs (in both directions)

are performed. These algorithms include finding the center of a circle using three points, tangent and two points, two tangents and one point, and three tangents. The third part includes the algorithm for a full search among all possible pairs and triples of vectors found in other parts of the implementation.

The result obtained is new. Prior to this, there has been only a theoretical justification for the analytical method, but no ways for its implementation that could be officially referred to could be found. As a result, this algorithm was implemented. The resulting implementation was tested on a large number of pairs of convex polygons of various types. This result is of independent value, both for subsequent testing of any approaches to optimization, and for testing any sub gradient methods During the operation of the algorithm, which performs a complete search among all possible pairs an triples of vectors, statistical data about which vectors influence the formation of the final optimal result were accumulated. Based on the processing results of these data, Hypothesis 1 was formulated. Its idea is that some groups of vectors can be excluded from the search, since they do not participate in the formation of the final optimal result. It was suggested that such vectors are those that go from one polygon to another but intersect any side of the other polygon.

Hypothesis was tested on a set of polygons, based on which the hypothesis was formulated. But when the set of polygons was expanded, counter examples were found. Hypothes is 1 was no confirmed. Nevertheless, this heuristic idea is viable, since in quite a large number of cases for polygons without peculiar features, Hypothesis 1 is fair and provides a substantial reduction in the search options.

Due to finding a counter example for Hypothesis, a new hypothesis was required. This hypothesis was based on the idea of using a support function. To begin with, recall the definition of the Hausdorff distance through support functions [5].

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Аннотация. Мы изучаем вычислительную сложность расстояния Хаусдорфа двух кривых на двумерной плоскости в контексте теории сложности реальных функций на основе машины Тьюринга. Доказано, что расстояние Хаусдорфа любых двух вычислимых за полиномиальное время кривых является левым вещественным числом ΣP. Неточная точка моделируется диском, заданным его центром и радиусом. Фактическое положение неточной точки может находиться в любом месте ее диска. Из-за направления расстояния Хаусдорфа и того, вычисляется ли его жесткая верхняя или нижняя граница, необходимо рассмотреть несколько случаев. Для каждого случая мы либо показываем, что вычисление является NP-трудным, либо представляем алгоритм с полиномиальным временем выполнения.

Ключевые слова: Хаусдорфово расстояние, теория оптимального управления, вычислительная сложность, двумерная плоскость.

Annotation. We study the computational complexity of the Hausdorff distance of two curves on the two-dimensional plane, in the context of the Turing machine-based complexity theory of real functions. It is proved that the Hausdorff distance of any two polynomial-time computable curves is a left-ΣP real number. An imprecise point is modeled by a disc given by its centre and a radius. The actual position of an imprecise point may be anywhere within its disc. Due to the direction of the Hausdorff distance and whether its tight upper or lower bound is computed, there are several cases to consider. For every case we either show that the computation is NP-hard or we present an algorithm with a polynomial running time.

Keywords: Hausdorff distance, Optimal control theory, Computational complexity, Two-dimensional plane

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Introduction

In 2012, more than 31 million flights were made worldwide. Hence, we can conclude that more than 85,000 aircraft fly over our heads every day, and even more are expected in 2021. In total, 3 billion passengers were transported in 2012, i.e. almost half of the world's population. Each passenger provides personal data, and there is a continuous process of information exchange between all parts of the system: when selling a ticket, when ground handling passengers, when performing a flight, when preparing an aircraft for flight. Information about transportation should be transmitted only through secure channels with mandatory compliance with the requirements that exclude any illegal actions with this data. Such a large amount of data needs to be protected.

Main part

The problems of information protection of industrial telecommunications systems in our time are an integral part of the activities of the entire aviation and transport system of the country. The more information is concentrated in the information system, the more people want to get it, and the more complex the system itself is, the more possible vulnerabilities it has. According to statistics, it is internal threats that account for 70% of leaks of valuable information [3, 4].

The main basis for the organization of the process of ensuring information security of telecommunications systems is the adopted security policy. This policy should be formed in such a way as to determine exactly the threats and how the information in the information protection objects is protected. Security policy refers to various ways of ensuring information security, which are organizational, that is, the selection and training of employees, physical measures-restricting physical access to protected information, and technical measures – various means of protecting information from leakage through technical communication channels, cryptographic means of protecting information, and protection systems against DDOS attacks. Any information protection measures require security measures [1].

Each telecommunications system of civil aviation uses its own set of methods and methods of information protection, while it is possible to distinguish two main areas of information protection: ensuring the security of information, and protection against errors. A set of methods for ensuring the security of information is aimed at concealing the transmitted information and preventing the imposition of false information. The complex of methods for ensuring information security includes: cryptographic methods for protecting information, electronic digital signature and authentication. It

should also be noted that the most effective provision of information security is implemented in the presence of a single mechanism – a single system for ensuring information security. Moreover, the presence of such a system makes it possible to more reliably protect information and information resources by rationally managing all forces and means, which generally determines the quality of the security system functioning [5].

One of the ways of protectionof civil aviation will be the use of special backup systems that work independently of each other; however, this only minimizes the likelihood of any incident, but does not guarantee complete safety [2]. In addition, it is important to protect the systems of civil aircraft from outside interference, in particular, if it is a question of providing Internet access services, the equipment that provides data transmission should be completely isolated from the onboard systems, if it is a question of transmitting data to the crew from the ground, the information should undergo a verification procedure. And the main measures of protection against errors include noise-resistant encoding and character interleaving, the use of signals with a broad spectrum, changing signal parameters and the use of narrowly directed antennas. In addition to the basic requirements for the information security system of civil aviation facilities, it is also possible to define recommendations, the implementation of which will allow you to more reliably organize the protection of information:

– security tools should be simple in terms of technical use, as well as intuitive for users;

– it should be possible to disable the protection system only in emergency cases;

– the system for ensuring information security of civil aviation facilities should not depend on the objects of protection;

– minimal dissemination of information about the availability of information protection systems for civil aviation facilities.

Compliance with these requirements when creating and using information security systems for civil aviation facilities will allow for more reliable protection of information and information resources.

It should be borne in mind that when organizing an information security system, there are some aspects:

– formal, which involves the definition of criteria that must meet the protected information technologies;

– practical, it defines a set of information security measures in relation to the information technologies under consideration.

Planning of information security measures is necessary to organize the interaction of all interested management bodies of civil aviation facilities, the

protection of information resources should be specific and targeted, that is, it is necessary to protect specific information resources.

Conclusion

In the field of aviation, there are enough measures, recommendations, methods and means of information protection, passengers can be sure of the security of their data, because ensuring the information security of civil aviation facilities is one of the priorities of the authorities and management of the industry, as well as one of the guarantees of a high level of flight safety, and the safety of various air transport organizations.

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Аннотация. В этой статье рассматриваются проблемы информационной безопасности в гражданской авиации, и способы осуществления безопасности данных пассажиров. Каждый пассажир предоставляет персональные данные, идет непрерывный процесс информационного обмена между всеми звеньями авиационной системы, информация о перевозках должна передаваться только по защищенным каналам. Как защитить такой огромный объем данных? Главное для организации процесса обеспечения информационной безопасности-это принятая политика безопасности. Политика безопасности относится к различным мерам информационной безопасности, которые являются организационными, физическими и техническими. Помимо методов, существует множество различных средств защиты.

Пассажиры могут быть уверены в сохранности своих данных, ведь обеспечение информационной безопасности объектов гражданской авиации является одним из приоритетов этой отрасли, а также одной из гарантий высокого уровня безопасности полетов.

Annotation. This article discusses the problems of information security in civil aviation, and how to implement the security of passenger data. Each passenger provides personal data, there is a continuous process of information exchange between all parts of the aviation system, information about transportation should be transmitted only through secure channels. How to protect such a huge amount of data? The main thing for the organization of the information security process is the adopted security policy. Security policy refers to various information security measures that are organizational, physical, and technical. In addition to the methods, there are many different means of protection.

Passengers can be confident in the safety of their data, because ensuring the information security of civil aviation facilities is one of the priorities of this industry, as well as one of the guarantees of a high level of flight safety.

Keywords: Information security, civil aviation, security features,telecommunications systems, data security.

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APPLYING OPERATING CALCULUS TECHNIQUES TO SOLVE CURRENT ELECTRICAL ENGINEERING PROBLEMS

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Introduction. Mathematics is the universal language of engineers, which allows the use of natural science and general engineering knowledge, analytical methods in professional activities. To work on modern high-tech equipment, specialists are needed who have the ability to analyze and calculate complex electrical circuits. Due to the study of mathematics, future engineers know and are able to apply mathematical methods necessary for solving typical professional problems.

This paper discusses the application of an integrated method for calculating complex electrical circuits of alternating current, which can be used by cadets of the specialties 26.05.07 "Operation of ship electrical equipment and automation equipment" and students of the training direction

13.03.02 "Power Engineering" in the course "Electrical Engineering" and "Theory of Automatic Control".

In electrical engineering, problems are solved in which the main parameters of an electrical circuit are calculated by various methods, for example, by methods of linear algebra [1], methods of operational calculus [2], using information technologies [3] and others.

Purpose. This paper discusses the application of an integrated method for calculating complex AC electrical circuits.

The main part.

One should consider the Laplace transform for the elements of electrical circuits. As we know, sinusoidal signals can be described and calculated using a complex plane by replacing sinusoidal values with their complex images. But a sinusoidal signal is a special case of the spectrum of signals used in electrical circuits. If we consider not only sinusoidal signals, then in general form, any signal is a function of time, and it is defined for positive values of the variable (it is assumed that the electrical circuit is switched on at the moment of time t=0):

- $u = f(t)\,, t > 0\;$;
- $i = g(t)\,, t > 0$
- $u = 0\,; i = 0\,, t = 0.$

If we apply the Laplace transform for these functions and consider the effect of signals on the elements of the electrical circuit, we will obtain relations that are analogous to complex resistances, but written in the general case for signals of any shape.

Operator resistances of electrical circuit elements

If an element of an electric circuit is under voltage *u (t)* and a current *i (t)* flows through it, then we can introduce the concept of an operator resistance of an element [4].

Active operator resistance:

$u(t)i(t)=R \rightarrow U(p)I(p)=R.$

Inductive operator resistance:

$$u(t) = L\frac{di}{dt} \quad \rightarrow \quad U(p) = LI(p)p \quad \rightarrow \quad \frac{U(p)}{I(p)} = Lp = X_L$$

В данном случае начальные условия не учитываются, так как i(0)=0.

Capacitive operator resistance:

$$u(t) = \frac{1}{C}\int i(t)dt \quad \rightarrow \quad U(p) = \frac{I(p)}{pC} \quad \rightarrow \quad \frac{U(p)}{I(p)} = \frac{1}{pC} = X_C$$

Similar to inductive reactance, the initial conditions are not taken into account, since u (0) = 0.

Operator resistances are more common for any waveform. With a sinusoidal form of the signal, we have:

- $p \to jw$,
- $X_L \to jwL$,
- $X_C \to \frac{1}{jwc}$.

When using operator resistances, it is possible to analyze the electrical circuit under external influence and determine some of its important characteristics, such as transfer function, amplitude-frequency, phase-frequency characteristics, etc.

An example of calculating an alternating current electrical circuit [5].
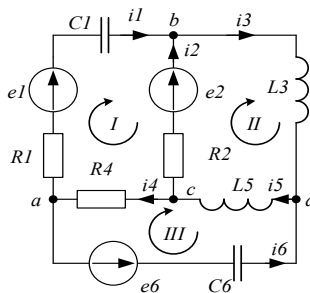
Figure 1 – Diagram of AC

The initial data for the diagram is as follows:

$$e_1(t)=100\sin(314t+30°); \; e_2(t)=120\sin(314t\text{-}30°);$$
$$e_6(t)=200\sin(314t+30°); \; C_1=50 \text{ мкФ};$$
$$C_6=20 \text{ мкФ}; \; L_3=30 \text{ мГн}; \; L_5=90 \text{ мГн};$$
$$R_1=20 \text{ Ом}; \; R_2=15 \text{ Ом}; \; R_4=12 \text{ Ом}.$$

It is necessary to determine the currents: $i_1, i_2, i_3, i_4, i_5, i_6$.

This circuit has all three basic elements: an EMF source, a capacitor and an inductor.

We compose a system of equations in complex form for finding the currents of a given three-circuit AC electric circuit according to the Kirchhoff's laws for nodes a, b, c and I, II, III circuits:

$$a) - i_1 + i_4 - i_6 = 0;$$
$$b) i_1 + i_2 - i_3 = 0;$$
$$c) i_5 - i_4 - i_2 = 0;$$
$$I) i_1 R_1 + \frac{1}{C_1} \int i_1 dt - i_2 R_2 + i_4 R_4 = e_1 - e_2;$$
$$II) i_2 R_2 + L_3 \frac{di_3}{dt} + L_5 \frac{di_5}{dt} = e_2;$$
$$III) i_4 R_4 + L_3 \frac{di_5}{dt} - \frac{1}{C_6} \int i_6 dt = e_6.$$

A nonlinear system of equations is obtained, which contains six equations with six unknowns, integral and differential elements. We can solve such a system of equations using a complex solution method, which consists in replacing real sinusoidal quantities with complex expressions.

The initial data in a complex form looks as follows:

$$E_1 = 100 e^{30° j}; \quad E_2 = 120 e^{-90° j} \quad E_6 = 200 e^{90° j}$$
$$C_1 = 50 \cdot 10^{-6}; \quad C_6 = 20 \cdot 10^{-6};$$
$$L_3 = 30 \cdot 10^{-3}; \quad L_5 = 90 \cdot 10^{-3};$$
$$R_1 = 20; \quad R_2 = 15; \quad R_4 = 12$$
$$f = 50; \quad X_{l_3} = \omega L_3; \quad X_{c_1} = \frac{1}{\omega C_1};$$
$$\omega = 2\pi f; \quad X_{l_5} = \omega L_5; \quad X_{c_6} = \frac{1}{\omega C_6}.$$

We compose a system of equations in complex form to find the currents of a given three-circuit AC electric circuit

$$a) - \dot{\;}_1 \cdot \dot{\;}_4 \quad \dot{\;}_6 \quad \dot{\;},$$
$$b). \dot{\;}_1 \cdot \dot{\;}_2 \quad \dot{\;}_3 \quad \dot{\;},$$
$$c). \dot{\;}_5 \quad \dot{\;}_4 \quad \dot{\;}_2 \quad \dot{\;},$$
$$I). \dot{\;}_{1} \quad \dot{\;}_{c_1} \quad \dot{\;}_2 \dot{\;}_2 \quad \dot{\;}_4 \dot{\;}_4 \quad \dot{\;}_2,$$
$$II). \dot{\;}_2 \dot{\;}_2 \cdot \dot{\;}_3 \dot{\;}_{l_3} \cdot \dot{\;}_3 \dot{\;}_{e_5} \quad \dot{\;}_2,$$
$$III). \dot{\;}_4 \dot{\;}_4 \quad \dot{\;}_5 \quad \dot{\;}_{l_5} \quad \dot{\;}_6 \quad \dot{\;}_{c_6} \quad \dot{\;}_6.$$

We solve the system of equations using the mathematical package MathCAD [6]. One can find the value of the currents in the circuit, as well as their instantaneous values:

The instantaneous values of the currents after the transition from the complex form will have the following form [5]:

$$i_1(t) = 0.704 \sin(314t + 150.579)$$
$$i_2(t) = 3.463 \sin(314t - 76.268)$$
$$i_3(t) = 3.025 \sin(314t - 86.05)$$
$$i_4(t) = 1.67 \sin(314t + 137.399)$$
$$i_5(t) = 2.27 \sin(314t - 100.399)$$
$$i_6(t) = 0.997 \sin(314t + 128.126)$$

Conclusion.

1. The application of an integrated method for calculating a complex AC electrical circuit is considered.

2. The solution to the problem was carried out using the mathematical package MathCAD.

3. Knowledge of the methods of operational calculus is necessary for studying the disciplines "Theoretical foundations of electrical engineering", "Theory of automatic control", as well as future work in the specialty of cadets in the specialties 26.05.07 "Operation of ship electrical equipment and automation equipment" and the direction of training 13.03.02 "Power Engineering ".

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Калининградский государственный технический университет [и др.]. – Керчь: КГМТУ, 2020. – 481 с. URL: https://clck.ru/UeRV6

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Annotation. The article describes the use of a complex method for calculating a complex electrical circuit. The solution was made using the mathematical package MathCAD.

Keywords: electrical circuit, alternating current, complex method, capacity, inductance, current, voltage, MathCAD**.**

Аннотация. В статье описано использование комплексной методики расчета сложной электрической схемы. Решение было выполнено с использованием математического пакета MathCAD.

Ключевые слова: электрическая цепь, переменный ток, комплексный метод, емкость, индуктивность, ток, напряжение, MathCAD.

UDC 621

ANALYSIS OF ATTACKS AND THREATS DIRECTED AT THE FACULTY'S WEBSITE RADIO ENGINEERING AND INFORMATION SECURITY CHVVMU.RU

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Introduction.

Ensuring the security of the site is a continuous process, unlimited in time. Every time the site is checked and the vulnerabilities found are fixed, the new ones are found. Site administrators need to constantly conduct information security audits. Only through regular risk analysis the measures to eliminate them can be identified.

The main part.

This article discusses and analyzes the blocking attacks received on the faculty's website chvvmu.ru, using the Wordfence security plug-in with a built-in firewall. Using a firewall filter that monitors incoming and outgoing traffic, the plug-in blocks malicious code until it reaches the site. The

Wordfence security plug-in configures protection against various types of attacks and malware, updates malware signatures, and compares the main site files with those found in the repository WordPress.org, checks their integrity, restores files that have been modified by overwriting their original version [2].

The report provided by the plug-in to the administrator of the faculty website is analyzed. The statistical data obtained are shown in Table 1.

Table. Number of common attacks entering the server

Block type	Complex attacks	Full Brute force attack	Total
Today	197	3	200
Week	1382	118	1500
Month	5522	397	5919

Using the "LiveTraffic" Wordfence function, the site in real time operation mode is analyzed. The function allows adjusting the parameters to speed up the search for the necessary information. The user authentication for a month is analyzed; the parameter "Logins and Logouts" is set. (Fig. 2)

Figure 2 – Site chvvmu.ru authorization table

45 login attempts per month were identified. 18 of them were successful, the login was realize from two accounts (the same IP addresses were used), which automatically makes unsuccessful login attempts of these users in the number of 3 harmless attempts. Hence, there were 24 unsuccessful ones. These 24 addresses become the objects of analysis for the site administration. These poorly authorized users are immediately placed in the "dangerous" category by Wordfence, which makes it easier to monitor incoming users on the faculty's website.

Based on the analysis of one of the users who did not pass authorization, the method for investigating suspicious is show. The administrator opens the extended account information and sees the date and time of the user's attempt to log in the site, its IP address and host name, the browser and system from which the data was entered and the login object-a person/bot.

Figure 3 – User who did not pass authorization

This example shows that a person tried to log in, the location, Poland, Gdansk, is determined the IP address. Then what to do with this account should be decided: to block the IP address, run the whois (network protocol), view the latest traffic. For example, if a network protocol, and see the results are the following:

Figure 4 – Fragment from the user's network protocol

The administrator can find out the name of the role account, the user's email address, the route of the IP address, the date of its last change, etc., and based on the available data, make a decision on the account: block it or continue to investigate further.

This is how the site chvvmu.ru authorization attempts are regulated and analyzed, which has high-quality protection in the item "User authorization security". It remains for the administrators to monitor authentication attempts and block accounts if non-standard activity is detected.

Using the "Blocked" parameter the addresses which were blocked on the site and why can be examined. The list of 250 blocked IP addresses signals a large number of attacks entering the faculty's website.

The attacks on the faculty's website are serial in nature. That is, multiple attacks are accomplished from the same IP address. For example, in the last hour, 23 attacks of the same IP address were committed on the site. (Figure 5).

Figure 5 – User information

This IP address was blocked by the firewall for uploading a malicious file to the file: files=mNOFeDrT.php in http://www.chvvmu.ru/wp-content/plugins/wp-symposium/server/php/index.php. In the file index.php the source code of the site is stored, changing it can lead to serious consequences, so if the plug-in did not block the attack on one's own, the administrator might not have time to react, or even to notice the attack at all. The non-serial account blocking is analyzed. (Figure 6).

Figure 6 – User information

The accounts previously considered as not authenticated were listed as "dangerous". The user was immediately blocked because the site chvvm.ru protection plug-in immediately blocks the IP address if it identifies a bot.. It remains for the administrators to confirm the blocking of these addresses.

Below there is an example of a user who has executed a series of different attacks on the faculty website over a short period of time. He tried to bypass the directory – wp-config.php in the query string: thumb=..%2Fwp-config.php, create a request containing unauthenticated stored cross-site scripts, wanted to download malicious files (patterns). (Figure 7).

Figure 7 – A series of attacks on the site chvvmu.ru

There were 163 attacks accomplished from this IP address. This IP address purposefully sought to gain access to the data and files stored on the site. Therefore, administrators need to thoroughly analyze the source of attacks, and if possible, block addresses that may even indirectly relate to the attacker.

Conclusion.

WordPress is a fairly large and complex product that has its own advantages and disadvantages. Among the latter, there are a large number of vulnerabilities. The Wordfence plug-in allows protecting the faculty's website chvvmu.ru, blocking a lot of attacks entering it. Among the most common attacks on the site are: hacking, downloading malicious files, DDoS attacks, SQL injections.

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Аннотация. В данной статье анализируются угрозы, поступающие на сайт факультета радиотехники и информационной безопасности, изучаются тенденции и закономерности атак и предлагаются возможные способы предотвращения таких уязвимостей в будущем. Сайт chvvmu.ru рассматривается как объект исследования информационной безопасности.

Ключевые слова: защита сайта, плагин, брандмауэр, паттерны, анализ, авторизация, атака, IP-адрес, Wordfence (плагин безопасности).

Annotation. This article analyzes the threats entering to the website of the Faculty of Radio Engineering and Information Security, examines the trends and patterns of attacks, and suggests possible ways to prevent such vulnerabilities in the future. The site chvvmu.ru is considered as an object of information security research.

Keywords: site protection, plug-in, firewall, patterns, analysis, authorization, attack, IP address, Wordfence.

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INFORMATION SECURITY MONITORING SYSTEMS FOR AUTOMATED CONTROL SYSTEMS

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1. Introduction

Every company, without exception, has been threatened at least once by unauthorized access to information resources. Among such attacks, it is worth highlighting: malware, social engineering, company personnel. The reasons accompanying the implementation of unauthorized access should be attributed to the low level of computer literacy of the organization's employees. At the moment, not every employee is aware of the correct and reliable use of information systems. Outdated software may also be vulnerable. It is not so easy to detect and fix this problem in a timely manner, especially if the organization has several hundred or thousands of pieces of equipment on its account.

2. Main part

The development of digital infrastructure is only gaining momentum every year. In this regard, the risk of leakage of confidential information increases. It is impossible to completely eliminate this problem, but the immediate identification of such threats is the key to solving it.

It is possible to implement these measures by monitoring information security. It consists of collecting, aggregating, correlating, and analyzing data on the state of the information infrastructure of the corporate network, as well as its users.

The purpose of information security monitoring is to quickly identify actions related to unauthorized access of employees or unauthorized persons who have penetrated the corporate network. These monitoring systems notify about the presence of a vulnerability, thereby helping to eliminate it in a timely manner.

From a technical point of view, information security monitoring is an automated process of checking all security events. Information is collected from various types of sources, which can serve as: operating system logs; network equipment; antivirus applications; specialized software that analyzes the security of the infrastructure.

Structure of the Information Security Monitoring System is shown in Fig.1.

These systems combine security information management (SIM) and security event management (SEM). They provide real-time analysis of security alerts generated by applications and network equipment. SIEM systems can have hundreds or thousands of correlation rules. Some of them are simple, and some are more complex. Once the correlation rule is triggered, the system can take appropriate steps to prevent a cyberattack. This usually involves sending a notification to the user, and then possibly limiting or even shutting down the system. In the event that an attack was detected, the SIEM system will be able to provide the necessary evidence base for investigations [1, p. 2-5].
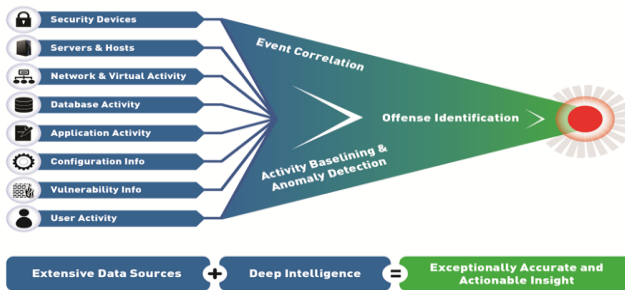
Figure 1 — Security Information and Event Management

The data for SIEM comes from different sources:

— event logs that are logged by the operating system or a third-party application;

— network hardware (routers, proxies, gateways, etc.);

— firewalls, CRM systems;

— vulnerability scanners — special software that finds vulnerabilities inside the infrastructure.

User Behavioral Analytics

User Behavioral Analytics (UBA) is a system whose actions are aimed at identifying insider threats, targeted attacks, and financial fraud. UBA studies the actions of human behavior, and then identifies anomalies in them that indicate potential threats. Security systems provide so much information

that it is difficult to disclose information that really indicates the potential for a real attack. Analytical tools help you understand the huge amount of data collected by SIEM, IDS/IPS, and system logs. UBA tools use a specialized type of security analysis that focuses on the behavior of systems and the people who use them.

Structure of User Behavioral Analytics is shown in Fig.2.

Within the framework of the existing understanding of the application of UBA solutions, the following areas of use of this relatively new technology are distinguished:

— collecting and providing information about behavior;

— behavior monitoring;

— identifying malicious insiders;

— preventing data leaks;

— identify compromised user accounts;

— detection of unauthorized access to data;

— identification of targeted cyber-attacks and threats against which protective mechanisms have not yet been developed.
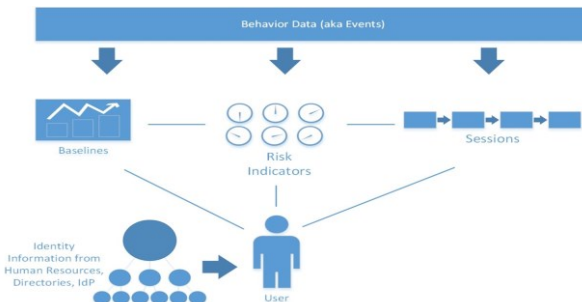
Figure 2 — User Behavioral Analytics

User and Entity Behavioral Analytics

User and Entity Behavioral Analytics (UEBA) focuses on analyzing activity, especially user behavior, device usage, and security events in a network environment to help companies detect potential insider threats and compromised accounts. UEBAS create a baseline of standard behavior for users and organizations on the corporate network and look for deviations to the baseline by alerting network administrators or security teams to anything that might indicate a potential security threat. UEBA collects operational data, including user actions (such as applications used, data interactions, keystrokes, mouse movements, and screenshots), actions on devices connected to the network (such as servers, routers, and data stores), and

security events from supported devices and platforms. Advanced analytical techniques are then applied to this data to model the baseline of activity. Once this baseline behavior level is established, the UEBA solution will continuously monitor the behavior on the network and compare it with the established baseline, looking for behavior that goes beyond the established activity threshold to alert the appropriate teams of the detected anomaly.

The basic system flow of UBA / UEBA / NBAD systems consists of four stages [2]:

1. Data collection. Collect logs and packet/data captures from all possible/available sources: firewalls, antiviruses, syslog, event logs, tap and sniffing devices, Intrusion Detection and Prevention Systems, network Management;

2. Data normalization and storage. Extract and store relevant information in a common and centralized manner;

3. Analyze the data to identify abnormal behavior by comparison with an expected one;

4. Report/alert the abnormal behavior to IT and security experts.
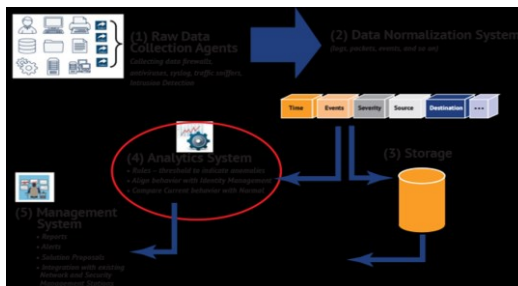
Figure 3 — UEBA high-level architecture

Conclusion

As the modern workplace becomes increasingly cloud-based and digital, the traditional perimeter of the network is being eroded. Cyber threats are evolving to take advantage of new vulnerabilities that appear daily. While preventive security technology is capable of creating known threats based on signatures, cybersecurity threat monitoring is necessary to identify more complex threats that circumvent these controls.

Continuous cybersecurity monitoring helps organizations detect a wider range of threats, reduce the time it takes to respond to attacks, and comply with industry and regulatory requirements.

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Аннотация. Целью данной статьи является анализ важности внедрения мониторинга информационной безопасности автоматизированных систем управления в организации. Системный мониторинг обеспечивает возможность обнаружения реальных или предполагаемых атак на системы и бизнес-сервисы, а также позволяет убедиться в том, что системы используются правильно в соответствии с организационными политиками.

Ключевые слова: информационная безопасность, мониторинг информационной безопасности, SIEM, UBA, UEBA.

Annotation. The purpose of this article is to analyze the importance of implementing information security monitoring of automated management systems in an organization. System monitoring provides the ability to detect real or suspected attacks on systems and business services, and also allows to make sure that the systems are used properly in accordance with organizational policies.

Keywords: information security, information security monitoring, SIEM, UBA, UEBA.

CURRENT PROBLEMS OF ENSURING INFORMATION SECURITY IN RUSSIA

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Introduction.

The topic "Current problems of ensuring information security in Russia" is relevant as the information security of Russia is formed and undergoes many changes under the time of time, new technologies and

other influences until now. The problems in the field of information security are multiple and require complex solutions. In XX-XXI century, it was accompanied by the rapid flowering of new information and communication technologies and their invasion into almost all spheres of human and society life. At the state level in the Russian Federation, the tasks of informatization and information security were consistently solved. New technologies for protecting information were developed and improved. This article analyzes some of them.

The main part.

In recent years, some practical measures have been taken to strengthen information security in the Russian Federation. The formation of regulatory support for information security has begun - the laws "On Security" and "On State Secrets" have been adopted, work has been launched to create mechanisms for their implementation, the preparation of bills regulating activities in the information sphere has been completed [3].

A number of measures have been taken to improve information security in public authorities and administration, in government organizations and at enterprises. The successful solution of a number of information security issues is facilitated by the creation of the State system for protecting information in the Russian Federation from foreign technical intelligence services and from its leakage through technical channels, as well as licensing systems for enterprises in the field of information security and certification of information security tools [2].

At the same time, an analysis of the state of information security in the Russian Federation shows that at present its level does not meet the vital needs of the individual, society and the state. Today's conditions for the political and socio-economic development of the state and society cause an aggravation of contradictions between the needs of society to expand the free exchange of information and the need to maintain certain restrictions on its dissemination by the state. The lack of effective mechanisms for regulating information relations in society and the state leads to many negative consequences. Poor provision of public authorities and management with reliable, timely and complete information makes it difficult to make informed decisions. Insufficient protection of the state information resource leads to the loss of important political, economic, scientific and technical information (including information about highly effective military and dual-use technologies) [1].

The underdevelopment of information relations in the field of entrepreneurship hinders the formation of a civilized market, and the lack of a mechanism for including the national information resource in the economic turnover leads to serious economic losses.

The loss of important information is facilitated by the unsystematic nature of data protection and poor coordination on a national scale of measures to protect information, departmental disunity in ensuring the confidentiality of information, insufficient control over the export of domestic science-intensive technologies, weapons and military equipment.

Measures to ensure the safety of state secrets, commercial and official secrets in government and administrative bodies and at enterprises of the defense complex have been seriously weakened. The protection of personal data, tax, customs, and property information is poorly organized.

The lag of domestic information technologies forces us to follow the path of purchasing unprotected imported equipment, as a result of which the likelihood of unauthorized access to databases and data banks increases, as well as the increasing dependence of Russia on foreign manufacturers of computer and telecommunications equipment and information products.

The state of affairs with ensuring information security in the Russian Federation is such that it does not allow it to join the world information system on an equal basis and requires urgent solutions to the following key problems:

1. Development of scientific and practical foundations of information security that meets the current geopolitical situation and the conditions of political and socio-economic development of the Russian Federation.

2. Formation of a legislative and regulatory framework for ensuring information security, including the development of a register of an information resource, regulations for information exchange for government and administrative bodies, enterprises, normative consolidation of the responsibility of officials and citizens for compliance with information security requirements.

3. Development of mechanisms for the implementation of citizens' rights to information

4. Formation of an information security system, which is an integral part of the country's overall national security system.

5. Development of modern methods and technical means that provide a comprehensive solution to information security problems.

6. Development of criteria and methods for assessing the effectiveness of information security systems and tools and their certification.

7. Research of forms and methods of civilized influence of the state on the formation of public consciousness.

8. A comprehensive study of the activities of information systems personnel, including methods of increasing motivation, moral and psychological stability and social protection of people working with classified and confidential information.

The solution to the above key information security problems should be carried out on the basis of an appropriate state policy.

Conclusion.

Thus, the problems of information security from a purely special area are moving into the social area - the area of protection of human and society rights. The state here becomes the only guarantor of their observance. The state can realize this function only through legislation, the latter in the field of informatization of society has just begun to take shape.

The Civil Code, the Criminal Code, the Criminal Procedure Code, the Code of Administrative Violations have only a few articles and provisions on information relations in society. With the entry of the country into the era of the information society, information law should inevitably arise, which, in terms of its influence on the life of society, will be of paramount importance.

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Аннотация. На сегодняшний день в России сформирована и продолжает совершенствоваться нормативно-правовая база обеспечения информационной безопасности, приняты законы, регулирующие общественные отношения в этой сфере и разрабатываются механизмы их реализации. Повсеместно продолжается работа по формированию и развитию национальной защищенной информационно-телекоммуникационной системы специального назначения в интересах органов государственной власти. В Российской Федерации создана достаточно обширная структура по обеспечению национальной безопасности. Однако сегодня она далека от совершенства, в ее описании отсутствует комплексность и системность.

В статье дается краткая характеристика состояния защищенности и определяются актуальные проблемы информационной безопасности

в России, препятствующие эффективному обеспечению информационной безопасности человека, общества и государства.

Данные проблемы определяют и конкретизируют направления дальнейшего совершенствования системы информационной безопасности Российской Федерации в современных условиях.

Ключевые слова: информационная безопасность, обеспечение национальной безопасности Российской Федерации, проблемы информационной безопасности.

Annotation. For today, Russia has formed and continues to improve the regulatory framework for ensuring information security, laws have been adopted that regulate public relations in this area, and mechanisms for their implementation are being developed. Everywhere, work is focused on the formation and development of a national secure information and telecommunications system for special purposes in the interests of public authorities. A fairly extensive structure for ensuring national security has been created in the Russian Federation. However, today it is far from perfect; there is no complexity and consistency in its description.

The article gives a brief description of the state of security and identifies topical problems of information security in Russia, which impede the effective provision of information security of a person, society and the state.

These problems define and concretize the directions of further improvement of the information security system of the Russian Federation in modern conditions.

Keywords: Information security, ensuring the national security of the Russian Federation, problems of information security.

APPLICATION OF FEMTOCELLS TO IMPROVE THE QUALITY OF COMMUNICATION SERVICE

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Introduction. Traditional mobile communications are known to be implemented mainly to provide affordable communications away from fixed wired telephones and to provide communications for mobile subscribers. In densely built-up conditions, far from the city or inside some premises, it is impossible to ensure the operation of a mobile telephone network. One of the possible solutions to this problem is the use of femtocells.

Main part. Femtocell is stated to be a miniature low-power cellular station that connects to the operator's network via a broadband Internet channel. The task of using femtocells is to provide cellular coverage within the radius of its action [4].

Femtocell, by its principle of operation, resembles a conventional wireless router, operates in a licensed frequency range of a mobile network and therefore can only be provided to the user by a cellular operator. In view of this, when using a femtocell, it is possible for a mobile phone to work with only one cellular operator, which is a limitation of this option for organizing access to mobile communications. The principle of interaction of elements in a mobile network using femtocell technology is shown in Fig. 1.
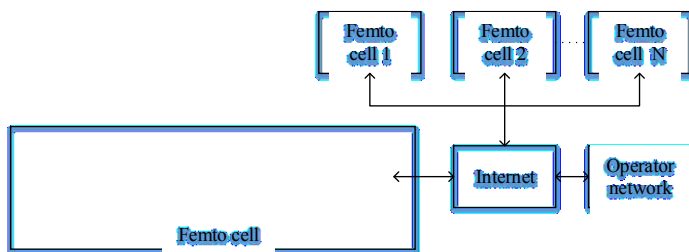
Figure 1 — The principle of interaction of elements in a mobile network using femtocell technology

Once within the range of the femtocell, the mobile phone is automatically registered in the mobile network. In this case, an SMS-message with information about the connection is sent to the phone. The user can make and receive calls, use high-speed Internet in the same way as when working in a regular operator's network, only in this case the signal is

transmitted through the femtocell and then through the broadband Internet channel in encrypted form to the gateway of the cellular operator.

The coverage area of one mini-base station can be 100-200 square meters, depending on the conditions of use, for example, the geometry of the room and the materials of the walls of the building. If necessary, you can use several femtocells and increase the network range.

Femtocell is a self-adjusting device, after it is connected to the Internet channel, it automatically connects to the gateway of the mobile operator, creates a secure tunnel connection, receives settings and is ready to work within a few minutes. Usually, a technological SIM card is installed in a femtocell, which is responsible for authentication in the operator's network [5, 7].

In addition, the device scans the air and determines the availability of access to neighboring femtocells and base stations of the operator, after which it automatically takes into account the possibility of switching to them for mobile terminals of users. At the same time, handover is supported (the transition of a subscriber from one base station to another without breaking the connection) when moving into the coverage area of the macrocell.

A variant of the structure of a femtocell station is shown in Fig. 2., the circuit includes the following elements: CPU, FPGA, ethernet, memory, digital receiver, digital transmitter and 2 power amplifiers. Control and signal processing is realized using central processing unit (CPU) and FPGA. The control program and data are stored in memory. Memory is a collection of NAND and NOR memory.

NAND allows to operate at once with large amounts of data, therefore it is used to store the main array of information. NOR memory is faster, but relatively small, therefore it is used to store small auxiliary data. With the help of Ethernet, communication with the network and data transmission between the femtocell and users are realized. The digital receiver organizes reception of the signal from the antenna. The digital transmitter organizes the signal transmission from the device to the antenna. These devices contain a digital to analog converter (DAC) and analog to digital converter (ADC) for converting an analog signal to digital for further work. Circular polarized antennas can be used for communication with subscriber equipment [1, 2, 3, 6, 8].
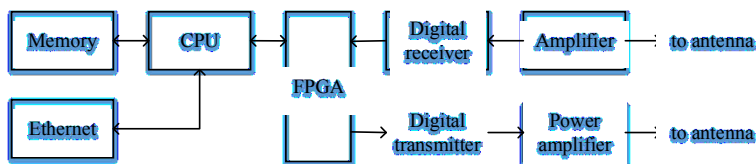
Fig. 2 — Femto station structure

Discussion and Conclusions. As a result, we get a system for increasing the coverage of the cellular network with the following advantages and disadvantages. The advantages are: high speed of data transmission and quality of communication, low power consumption due to low power of femtocells, increased coverage of the operator, ease of installation. The disadvantages are conflicts with an external cellular network, the need to synchronize with an accurate time source, the need for a stable Internet, the need to register equipment with Roskomnadzor at the place of installation.

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Аннотация. В докладе рассматривается вариант решения проблемы качества связи и расширения зоны покрытия сотовой сети в условиях плотной городской застройки и отдаленности от базовых станций. Проведен анализ имеющихся решений в области фемтосетей. Приведена структура фемтосети и описание ее архитектуры. Описаны особенности применения, системные требования и ограничения, достоинства и недостатки технологии. Результаты исследования показали, что реализовать данную систему при полном отсутствии сигнала от мобильных базовых станций или спутников не представляется возможным.

Ключевые слова: связь, базовая станция, мобильная сеть, фемтосеть, интернет.

Annotation. The report considers an option for solving the problem of communication quality and expanding the coverage of a cellular network in conditions of dense urban development and remoteness from base stations. The analysis of available solutions in the field of femto networks is carried out. The structure of a femto network and a description of its architecture are given. The features of application, system requirements and limitations, advantages and disadvantages of the technology are described. The results of the study showed that it is not possible to implement this system in the absence of a signal from mobile base stations or satellites.

Keywords: communication, base station, mobile network, femto network, internet.

DESIGNING THE COVERAGE AREAS OF WIRELESS WI-FI NETWORKS

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Introduction. In this paper, using the example of deploying a fragment of the university network, we study the operation of the Wi-Fi network. Usually, such problems are solved experimentally, but the paper shows the possibility of planning the network of an enterprise or institution by means of a model representation.

The purpose of the work is to determine the possibility of theoretical modeling of Wi-Fi networks using existing computer-aided design (CAD) systems and to experimentally verify the adequacy of the results obtained at the stage of theoretical research.

The relevance of the study is confirmed by the growing popularity of wireless Internet access systems. Tasks of the work: determining the general features of the construction and operation of Wi-Fi networks for transmitting information; determining the possible option for creating a building project using CAD; modeling a network fragment with the determination of the power level distribution; experimental study of the power level distribution.

The paper shows that modern wireless networks that meet the requirements of the IEEE 802.11 standards provide access to Internet resources. The possibility of creating a building project using CAD is determined. There is a technique [1], in this study, a network fragment was modeled with the determination of the power level distribution using a program. On the example of a real building of the academic building, a study of the power level was carried out, taking into account the influence of re-reflections from the walls, floor and ceiling. The work is of practical importance, since its results can be used in the planning of wireless networks of an enterprise or institution.

The main part. To perform the study, a general project was created in the environment of the program for electrodynamic modeling of wireless networks. This software is designed for wireless network engineers who plan, deploy, and maintain IEEE 802.11 a/b/g/n/ac networks.

The software system of electrodynamic modeling provides tools for easy planning, quick research, and visual representation of data. In figure 1. the plan of one floor of the building of the academic building of the Sevastopol State University for which the study was carried out is shown.
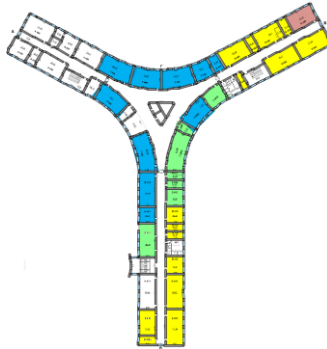
Figure 1 — The plan of one floor of the building of the academic
building of Sevastopol State University

Figure 2 shows the simulation result for the floor of the auditorium building in Bay B when a single wireless access point is installed in the corridor. A variant of the TP-LINK EAP220 access point configured for operation in the 2.4 GHz frequency range is considered [5]. The variant of application of the channel distribution scheme No. 1,4, 8 and 11 is considered.

The access point is installed on the ceiling of the corridor with the location of the antennas perpendicular to the ceiling surface. It is possible to use antennas [2, 3, 4]. The results given for channel 4 in the 2.4 GHz frequency range show that the use of a single access point provides coverage with a sufficient level of power only at a distance of several meters within the corridor, in the audience, the quality of coverage is insufficient.

Figure 3 shows the simulation result for the floor of the classroom building in Bay B when six wireless access points are installed in the corridor, the access points are distributed evenly along the corridor. The results show that the use of such an option for placing access points provides coverage with a sufficient level of power within the corridor, while in the classrooms the quality of coverage is insufficient. At the same time, the worst distribution of power flow density is observed in classrooms 403 and 405, in classrooms with a width of less than 3 m.
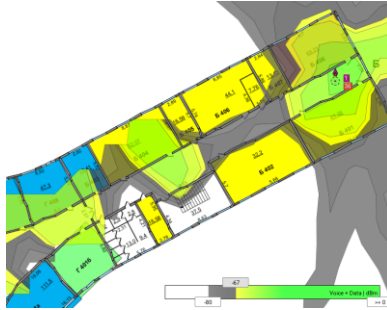
Figure 2 — Simulation result when installing a single access point
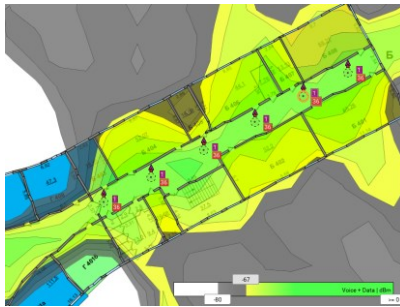
Figure 3 — Simulation result when installing six access points

At the next stage, the option of installing access points in large-area auditorium is considered. Thus, Figure 4 shows the simulation result for the floor of the school building in compartment B when installing six wireless access points in auditoriums 401, 402, 403, 404, 406 and 408. The result of the simulation shows that the placement of access points within the auditoriums provides good coverage for using access to the wireless network. Within the audience, the power flow density is sufficient for the operation of wireless devices. The power level is insufficient in the stairwell exit area and the sanitary area.

In the case of adding additional access points to eliminate the disadvantage described in Fig. 4., we get quite sufficient coverage, as shown in Fig. 5. Additional access points are placed in the compartment G of the educational building. The result of the obtained distribution ensures the operation of the network to the sector B of the building floor with a power level of at least –67 dBm.
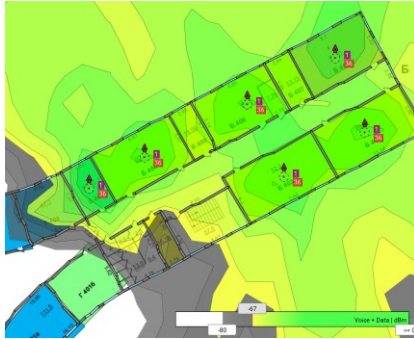
Figure 4 — Simulation result when installing six access points in auditoriums
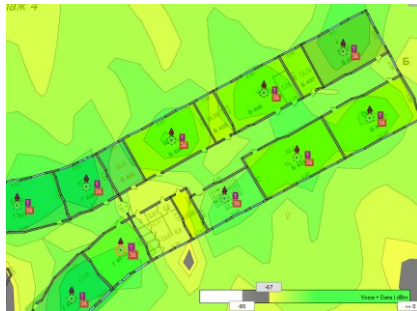
Fig. 5 — Simulation result when installing additional access points in auditoriums

Conclusion. Thus, a network fragment was modeled with the determination of the power level distribution using the CAD program. The sequence of operations performed at the modeling stage is determined. It is shown that it is necessary to install access points in auditoriums for 100% coverage of the floor of the university building. On the example of a real one, a study of the power level was carried out, taking into account the influence of re-reflections from the walls, floor and ceiling.

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Аннотация. Рост популярности беспроводных систем для доступа к интернет обуславливает актуальность разработки методик проектирования и внедрения сетей с радиопокрытием. В работе на примере развертывания фрагмента сети университета производится исследование работы сети Wi-Fi. Обычно подобные задачи решаются экспериментально, однако в случае создания сети предприятия или учреждения желательно иметь инструменты, позволяющие определить потребности в оборудовании беспроводной сети на этапе предварительного моделирования. В докладе приводятся результаты исследований, приводится порядок проведения моделирования и дается заключение о предпочтительном варианте размещения точек доступа в помещениях этажа учебного корпуса.

Ключевые слова; Wi-Fi, уровень мощности, точка доступа, моделирование, антенна.

Annotation. The growing popularity of wireless systems for Internet access determines the relevance of the development of methods for designing and implementing networks with radio coverage. In this paper, using the example of deploying a fragment of the university network, we study the operation of the Wi-Fi network. Usually, such tasks are solved experimentally, but in the case of creating a network of an enterprise or institution, it is desirable to have tools that allow you to determine the needs for wireless network equipment at the preliminary modeling stage. The report presents the results of research, provides the procedure for conducting simulations, and gives a conclusion about the preferred option for placing access points in the premises of the academic building floor.

Keywords: Wi-Fi, power level, access point, simulation, antenna

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INFORMATION BOARD WITH WI-FI CONNECTION

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Introduction. Arduino is a combination of hardware and software parts for simple electronics development. The hardware includes a large number of types of Arduino boards with built-in programmable microcontrollers, as well as additional modules. The software part consists of a development environment (a program for writing sketches and firmware for Arduino microcontrollers), a simplified programming language, and a huge set of ready-made functions and libraries.

Arduino was created to teach students and schoolchildren electrical engineering, programming, radio electronics, automation systems. With the help of microcontrollers, you can make not only educational projects, but also really useful devices. On Arduino, automation projects, smart home devices, portable weather stations, robotic manipulators and many other useful devices are created.

The main part. For programming microcontrollers on the Arduino platform, a special Arduino IDE development environment is used. This is a software for users that allows them to write their own programs (sketches) for the Arduino platform. This platform is primarily aimed at amateur designers who use Arduino to build simple automation and robotics systems.

The Arduino programming language is standard C++ (using the AVR-GCC compiler) with some features that make it easier for beginners to write programs in this business. The Arduino platform is the basis for many different devices, including the platform can serve as the basis for an information board [1, 2].

To fully control the information board, a main microcontroller is required, which will process the information and output it to the LED matrix, a Wi-Fi module that will allow you to control it via wireless communication channels, and a matrix of controlled LEDs to output the required information.

The Atmel ATmega328 is used as the control microcontroller. The main parameters of the microcontroller: operating voltage 5V; Clock frequency 16 MHz; memory size 32Kb Flash memory, 2KB RAM, 1Kb EEPROM; has connectors 1 x I2C, 1 x SPI, 1 x UART, 1 x ICSP [3].

The ATmega328 microcontroller is an 8-bit CMOS microcontroller with low power consumption, based on the advanced AVR RISC architecture [4].

The ATmega328/P microcontroller of the AVR family, like all the others, has an 8-bit processor and allows you to execute most commands in a single clock cycle. The controller also has special functions, such as: power-on reset and software detection of power supply voltage drop; internal calibrated clock generator; processing of internal and external interrupts; 6 sleep modes (reduced power consumption and noise reduction for more accurate ADC conversion). The appearance of the microcontroller is shown in fig.1.
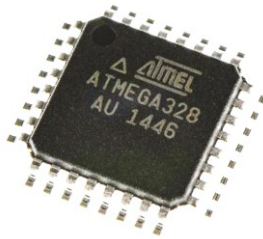
Figure 1 — Appearance of the microcontroller ATMega328

The ACP-12E Wi-Fi module is developed by Aichinger and is built on the basis of a processor with the ESP8266 core, the distinctive feature of which is the presence of a Wi-Fi radio interface [2].

The ESP8266 core is integrated into the Tensilica L106, a 32-bit microcontroller with ultra-low power consumption. Supports 80 and 160 MHz clock speeds, RTOS support, built-in Wi-Fi MAC/BB/RF/PA/LNA, microstrip antenna on the module board [2]. The module supports the IEEE802.11 b/g/n standard, a full stack of TCP / IP protocols. Users can use the modules either as an add-on to connect a device to the network, or as a separate network controller. Quick Specs: Built-in low-power 32-bit MCU; built-in 10-bit ADC; Built-in TCP/IP protocol stack; 2.4 GHz Wi-Fi, WPA/WPA2 support; wake up and transmit packets in 2 ms; +20 dBm output power in IEEE 802.11 b mode. The appearance Wi-Fi module ESP 8266 is shown in fig.2.

As the matrix, the address LED strip will be used, which is connected in series. Each LED of the tape can be controlled separately, which will allow to create different effects on the scoreboard.

Figure 2 — AppearanceWi-Fi module ESP 8266

The device will be controlled via a PC or a smartphone app. The control device will receive information about the output text, or about the effects on the scoreboard. Through a Wi-Fi connection, the information will be transmitted to the control controller, after which it will be displayed on the scoreboard.The block diagram of the information board with a Wi-Fi interface is shown in fig. 3.
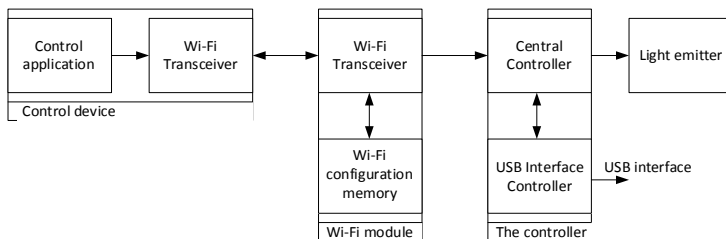
Figure 3 — Block diagram of the device under development

Conclusion. Thus, the Arduino platform and development environment were reviewed. The main nodes necessary for remote control of the information board are highlighted. The characteristics of the Atmel ATmega328 control microcontroller and the ACP-12E Wi-Fi module are given.

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Аннотация. В докладе проводится краткий обзор среды разработки Arduino IDE. Представлено описание платформы Arduino. Проводится оценка и выбор комплектующих для управления табло с беспроводным подключением, которое может использоваться в рекламных и оповещающих целях. Проводится обоснование и анализ выбора основных требуемых узлов устройства. Указаны основные электрические и сетевые характеристики выбранных элементов и приведены их характеристики. Представлена упрощённая блок-схемаразрабатываемого устройства, выполненная с использованием специализированных модулей из комплекта Arduino.

Ключевые слова: Arduino, Wi-Fi, микроконтроллер, информационное табло, блок-схема.

Annotation. The report provides a brief overview of the Arduino IDE development environment. The description of the Arduino platform is presented. The evaluation and selection of components for the control of the scoreboard with a wireless connection, which can be used for advertising and notification purposes, is carried out. The justification and analysis of the choice of the main required device nodes is carried out. The main electrical and network characteristics of the selected elements are indicated and their characteristics are given. A simplified block diagram of the device under development, using specialized modules from the Arduino kit, is presented.

Keywords: Arduino, Wi-Fi, microcontroller, information board, block diagram.

APPLICATION OF THE ARDUINO IDE DEVELOPMENT ENVIRONMENT FOR PROGRAMMING MICROCONTROLLERS

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Introduction. The Arduino IDE is an integrated development environment for Windows, macOS, and Linux operating systems, developed in the C and C++ programming languages, designed to create and load programs on Arduino-compatible controllers and devices, as well as on devices from other manufacturers [5].

The source code for the programming environment is released under the GNU General Public License version 2. It supports the C and C++ languages using special code structuring rules. The Arduino IDE provides a software library from the Wiring project that contains many common input and output routines.

User-written code requires only two basic functions to run the sketch and the main program loop, which are compiled and linked with the main program instruction into an executable loop program with the GNU toolchain. These elements are included in the IDE distribution. The system uses the avrdude program to convert the executable code to a text file in hexadecimal encoding, which is loaded into the Arduino board by the bootloader program in the device's embedded software.

The main part. The abbreviation IDE stands for Integrated Development Environment, which means integrated development environment. Using this environment, programmers write programs, and they do it much faster and more convenient than using conventional text editors, although they can also be used to write program code.

The Arduino IDE allows to create programs in a convenient text editor, compile them into machine code, and upload them to all versions of the Arduino board. The application is completely free, and you can download it on the official website of the Arduino community. The appearance of the program is shown in Figure 1.
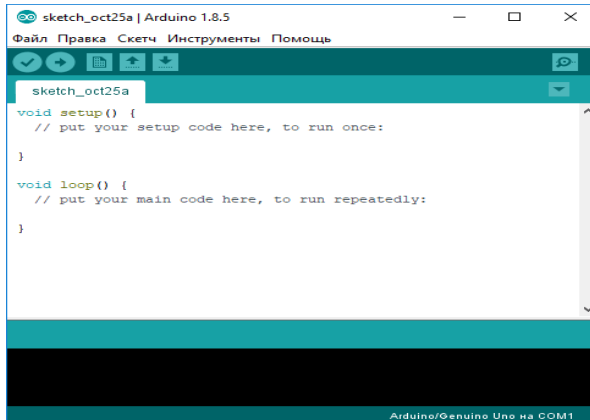
Figure 1 — Arduino IDE Window Appearance

The Arduino IDE interface is relatively easy to learn, based on a C++ - like programming language with predefined functions. Arduino programming uses a simplified version of the C++language. As in other C-like programming languages, there are a number of rules for writing code. Just like C++, the language is hard-typed and compiled. An example of a simple sketch for the Arduino IDE is shown in Figure 2.

Figure 2 — Sketch example in Arduino IDE media

The Arduino IDE also has a wide range of supported devices: Arduino UNO, Arduino Nano, ESP 32, ESP8266, Attiny family of microcontrollers, etc. It is possible to connect support for any devices via the built-in Arduino IDE board manager.

One should analyze the stages of preparing the Arduino IDE for programming the board using the example of ESP8266. The ESP-12E WiFi

module, developed by Ai-thinker, is built on the basis of a processor with an ESP8266 core, a distinctive feature of which is the presence of a Wi-Fi radio interface. The ESP8266 core is integrated into the Tensilica L106, a 32-bit microcontroller with ultra-low power consumption. It provides support for clock frequencies of 80 and 160 MHz, RTOS support, built-in Wi-Fi MAC/BB/RF/PA/LNA functions [6].

A microstrip antenna is integrated on the printed circuit board, made by analogy with [1, 2]. The module supports the IEEE 802.11 b/g/n standard, a full stack of TCP / IP protocols. Users can use the modules either as an add-on to connect a device to the network, or as a separate network controller.

After starting the development environment, go to the menu "File", "Settings". In this window, in the "Board Manager" field, you need to insert a link for the required board, in our case, the link will look like: http://arduino.esp8266.com/stable/package_esp8266com_index.json and click "Ok". Next, you need to go to the "Tools" menu, select the line "Board", "Board Manager". This opens the "Board Manager" window, in the list that opens, you need to select the desired board and install the necessary files for the development environment, in our case, about 150 MB. After that, the label "INSTALLED" will appear next to the name of the board. After that, you need to go back to the "Tools" menu, "Board" and the list of ESP8266 family boards will appear in the list that opens.

Conclusion. Thus, the report provides an overview of the Arduino IDE development environment. Screenshots of the program's working window and an example of code written in the environment are provided. Step-by-step instructions for configuring the Arduino IDE environment for working with boards that are not part of the Arduino family are described. The given method is used when performing the work [3, 4, 7].

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Аннотация. В докладе приводится обзор интегрированной среды разработки Arduino IDE. Доклад содержит скриншоты основного окна программы и код программы. Описываются возможности среды разработки по взаимодействию с платами, не принадлежащими к семейству Arduino. Представлена пошаговая инструкция настройки среды ArduinoIDE для работы с платами на примере Wi-Fi модуля ESP8266, состоящая из конфигурирования модуля «Менеджер плат» путем загрузки дополнительных модулей поддержки. Приведено краткое описание подключаемого модуля. Методика проверена при отработке практических задач, требующих использования для управления внешними элементами микроконтроллерного устройства.

Ключевые слова: Arduino IDE, среда разработки, программирование, ESP8266, микроконтроллер.

Annotation. The report provides an overview of the Arduino IDE integrated development environment. The report contains screenshots of the main program window and the program code. The capabilities of the development environment for interacting with boards that do not belong to the Arduino family are described. A step-by-step instruction for configuring the Arduino IDE environment for working with boards is presented using the example of the ESP8266 Wi-Fi module, which consists of configuring the "Board Manager" module by downloading additional support modules. A brief description of the plug-in is provided. The method was tested when working out practical tasks that require the use of external elements of a microcontroller device to control them.

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MOBILE NETWORK RESEARCH

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Introduction. In wireless data transmission systems, the following channel separation methods are used: Frequency Division Multiple Access (FDMA), which is mainly used in analog radio communication systems; Time Division Multiple Access (TDMA), the dominant technology for the mobile cellular network, is used in the D-AMPS, PDC and GSM standards; Code Division Multiple Access (CDMA), etc. For example, the current version of the 4G Long-Term Evolution (LTE) standard has two varieties: based on FDMA technology and based on TDMA technology.

Mobile access to Internet resources is implemented on the basis of 3G and 4G networks. However, it is quite difficult to determine the quality indicators of these networks in order to determine the optimal access option. Therefore, it is of interest to develop a methodology for evaluating the characteristics and features of the implementation of modern mobile access networks.

The main part. Well-known 3G mobile technologies: Universal Mobile Telecommunications System (UMTS); Wideband Code Division Multiple Access (WCDMA); High-Speed Downlink Packet Access (HSDPA) provide high-speed data transmission and mobile Internet. The DC-HSPA+ technology is the fastest 3G network standard in use. Such networks are often

referred to as 3.75 G. In DC-HSPA+ networks, the real speed of Internet access is comparable to the average performance of 4G networks.

The current version of the 4G standard is Long-Term Evolution (LTE), a standard for wireless high — speed data transmission for mobile devices. It is based on GSM / UMTS protocols, but the data transfer rates in LTE networks are much higher.

Orthogonal Frequency Division Multiple Access (OFDMA) in the downlink and Single Carrier Frequency Division Multiple Access (SC-FDMA) in the uplink are used as multiple access systems in LTE.

For conducting research, it is possible to use a modem with a USB interface. For example, the Huawei E3372h modem, which is designed as a standalone USB device. The modem works in 2G, 3G and 4G networks, in GSM / EDGE / FDD / TDD / UMTS / LTE modes. The maximum speed of data reception by the modem is up to 150 Mbit/s, the data transfer rate is up to 50 Mbit / s.

The modem works with any SIM cards of Russian and European telecom operators (YOTA, Megafon, MTS, Beeline, Rostelecom, Tele2, Volna, Win, Sevtelecom, etc.).

The menu of the modem's WEB interface allows you to set the mode of operation in 2G, 3G or 4G networks [1, 2]. It is important that the E3372h modem allows you to search for all the surrounding base stations of mobile 2G and 3G networks. And not only the base station of the operator of the sim card used in the modem, but all operators whose signal has a sufficient level for reception at the antenna placement point. For each station found, the cell ID CID and the level of the received signal are determined. The search is implemented in the AT-command mode. For example, the command to search for up to eight 3G base stations with a minimum signal strength of -100 dBm looks like:

AT^NETSCAN=8,-100,1 .

The result is displayed as a list sorted by signal strength. The highest base station in the list is the most powerful, and the lowest base station in the list is the weakest. For example, the modem response may look like (as shown in fig. 1).

^NETSCAN: 10788,,,2487,250,60,0,-97,8f7f,400000

ARFCH   LAC   MCC MNC BSID   LEVEL CID   BAND
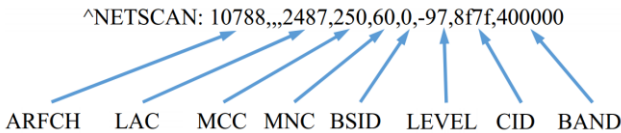
Figure 1 — Modem response format when scanning the availability of base stations

In fig. 1, the following symbols are used: ARFCN — the parameter that determines the operating frequency; LAC — the local area code; MCC — the country code in which the base station is located; MNC — the cellular network code (for example, for MTS, it has the code 01, MegaFon — 02, NSS — 03, SMARTS — 07, Tele2 — 20, Yota — 11, WIN-Mobile (K-Telecom) — 32, SevMobile — 33, Krymtelecom — 34, Wave mobile — 60, Beeline — 99, etc.); BSIC — identification code of the GSM base station; LEVEL — the level of the signal received from the base station in dBm; CID (Cell ID) — the cell ID; BAND-defines the frequency range in which the base station operates.

To get data on the connection of the base station, you can use the HUAWEI B315s-22 multifunctional device, which includes: a router, a modem for a mobile network of 2G, 3G and 4G standards, a port for connecting a wired phone for IP telephony, a combined LAN / WAN port of Gigabit Ethernet, three LAN ports of Gigabit Ethernet, a USB 2.0 port for connecting peripheral devices, a Wi-Fi access point and other elements. The main window of the router configuration programshown in fig. 2.

To get information about the device in the admin panel menu, select "?" and save the output parameters of the "Device Information" window, including parameters from "Device Name" to "Cell ID (hex/dec)". In the study, you should pay attention to the power level of the received RSSI signal and the base station ids LAC and Cell ID.
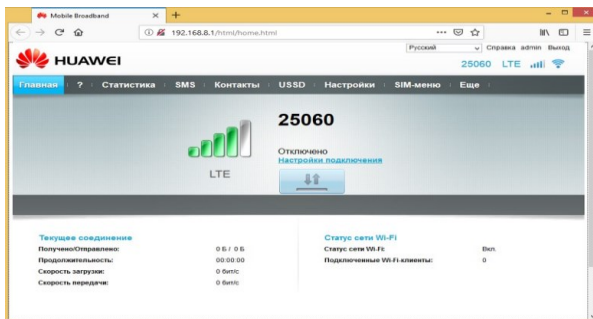
Figure 2 — The main window of the router configuration program

Conclusion. The report provides a methodology for studying the principles of data transmission in modern mobile communication networks and examples of using this methodology in practice using two variants of mobile devices. This method can be used in the educational process when training specialists in the telecommunications field by analogy with the methods [3, 4, 5].

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Аннотация. В докладе рассматривается методика изучение принципов передачи данных в сетях мобильной связи третьего и четвертого поколений, и практического определения возможностей мобильной сети по передачи информации. Рассмотрены известные мобильные технологии и обсуждается действующий вариант стандарта 4G – Long-TermEvolution (LTE), который является стандартом беспроводной высокоскоростной передачи данных для мобильных устройств. Показано, что для проведения исследований возможно использовать модем с USB интерфейсом. Например, модем Huawei E3372h. Кроме того, возможно использовать и многофункциональное устройство HUAWEI B315s-22, которое имеет в своем составе: маршрутизатор, модем мобильной сети и другие элементы. Методика позволяет получить определить уровень мощности принимаемого сигнала и идентификаторы базовой станции. Данная методика может быть использована в учебном процессе университетов при подготовке специалистов.

Ключевые слова. мобильная связь, базовая станция, модем, 3G, 4G, LTE

Annotation. The report discusses the methodology of studying the principles of data transmission in mobile networks of the third and fourth generations, and the practical determination of the capabilities of the mobile network for information transmission. The well-known mobile technologies

are considered and the current version of the 4G — Long-Term Evolution (LTE) standard, which is a standard for wireless high-speed data transmission for mobile devices, is discussed. It is shown that it is possible to use a modem with a USB interface for conducting research. For example, the Huawei E3372h modem. In addition, it is possible to use the HUAWEI B315s-22 multifunctional device, which includes: a router, a mobile network modem and other elements. The technique allows you to determine the power level of the received signal and the base station identifiers. This technique can be used in the educational process of universities in the training of specialists.

Keywords. mobile communication, base station, modem, 3G, 4G, LTE

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USING SYNCHRONOUS DIGITAL HIERARCHY EQUIPMENT IN A LABORATORY WORKSHOP

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Introduction. The paper considers the possibility of using the Synchronous Digital Hierarchy (SDH) equipment to build a laboratory stand for use in a laboratory workshop. We consider a variant of the professional OptiX Metro 1000 system, which is designed to build operator and corporate transport networks of the city scale. OptiX Metro 1000 equipment provides efficient transmission of SDH, ATM or IP traffic by installing appropriate interface modules [5].

The purpose of the development is to assist students in preparing and performing laboratory work on the discipline "Telecommunications systems", as well as in obtaining theoretical knowledge on the methods of

forming digital streams and practical skills in the methods of configuring and testing equipment of telecommunications equipment.

The main part. For the organization of the laboratory stand, it includes 2-4 OptiX Metro 1000 multiplexers configured to work with SDH streams. The equipment supports SDH technology transfer rates of STM-1 (155 Mbit/s transfer rate) and STM-4 (622 Mbit/s transfer rate). The reference network, built on OptiX devices, provides a dynamic distribution of bandwidth to users in accordance with the volume of traffic passing through, since the system uses a statistical, rather than a fixed method of data multiplexing.

The OptiX Metro 1000 equipment cross-switching matrix has the equivalent capacity of 16×16 VC-4 virtual containers; cross-switching is performed at the level of 1008×1008 VC-12 containers (2 Mbit/s traffic capacity). In the maximum configuration, the platform can support the transmission of 80 E1 streams.

It is also possible to install interface modules with a total number of ports: 6 E3 streams, 3 STM-4 streams, 6 STM-1 streams, 4 ATM streams with a speed of 155 Mbit/s. In addition, the multiplexers include Ethernet cards with two or eight 10/100 Mbit/s ports. Any port in such a module can operate in five modes: duplex or half-duplex (10 Mbit / s or 100 Mbit / s), as well as universal mode. After appropriate processing, the Ethernet frames are placed in VC-12 virtual containers. Data can also be packed into channels with a capacity of N×2 Mbit/s, but the total traffic of all ports should not exceed 48×2 Mbit / s [5]. To provide redundancy, the OptiX Metro 1000 uses mechanisms such as dual-fiber MSP, SNCP, virtual path protection in shared fiber, and redundancy rings. The OptiX Metro 1000 connector placement panel is shown in fig. 1.

Fig. 1 — View of the connector placement panel

The OptiX 155/622H (Metro1000) system operates under the continuous control of the OptiXiManager network management system. Via the Q interface, the OptiXiManager system can control the signaling, configuration, protection, and verification of the entire optical transmission system. Therefore, students are given the opportunity to build a network configuration according to the task previously formed by the teacher. In addition to the main functions of operation and maintenance, a monitoring

and maintenance function is provided. This enables efficient management of sub-networks, regional or even national networks. When performing laboratory work, the equipment can be configured in various modes. For example, an SDH ring structure can be implemented, as shown in fig. 2.
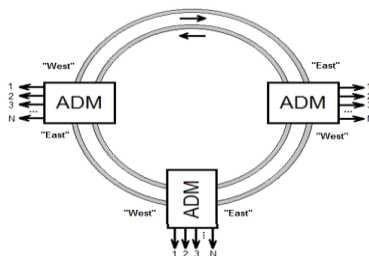
Fig. 2 — Ring structure of SDH based on three multiplexers

The example shows a variant using three multiplexers and a two-fiber communication line. Shown in fig. 2 provides the operation of the 1+1 redundancy scheme, which allows you to guarantee 100% network operation when the fibers break at any point of the ring route. Naturally, when performing laboratory tests, it is possible to implement other schemes for connecting the transport network. For example, the schemes "point-to-point", "sequential linear circuit", "star", etc. [4].

It is important that when installing all the elements of the system in one communication rack, it is possible to make operational changes to the connection scheme and implement research for various transport technology options. Thus, the laboratory stand provides an opportunity to implement a large number of options for students to perform research.

Conclusion. The report provides a methodology for studying the principles of building operator and corporate transport networks of the city scale. As a result of the implementation of the methodology, it is possible to study multi-service networks built using PDH, SDH, ATM and Ethernet technologies. This method can be used in the educational process of higher educational institutions in the training of specialists in the field of "Infocommunication technologies and communication systems" by analogy with the methods described in [1, 2, 3].

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Аннотация. В докладе рассматривается методика реализации лабораторного практикума для использования в учебном процессе высших учебных заведений при подготовке специалистов направления «Инфокоммуникационные технологии и системы связи». Методика основана на использовании оборудования SDH, обеспечивающего работу операторских и корпоративных транспортных сетей масштаба города. Показано, что использование оборудования OptiX 155/622H (Metro1000) обеспечивает возможность реализации схем подключения «точка-точка», «последовательная линейная цепь», «звезда» и «кольцо». Студенты при выполнении лабораторных работ имеют возможность реализации большого количества вариантов сетевых архитектур, построенных с использованием технологий PDH, SDH, ATM и Ethernet.

Ключевые слова: транспортная сеть, синхронная цифровая иерархия, оптическое волокно, лабораторный стенд, поток.

Annotation. The report discusses the methodology of implementing a laboratory workshop for use in the educational process of higher educational institutions in the training of specialists in the field of "Infocommunication technologies and communication systems". The methodology is based on the use of SDH equipment, which ensures the operation of operator and corporate transport networks of the city scale. It is shown that the use of OptiX 155/622H (Metro1000) equipment makes it possible to implement "point-to-point", "serial linear circuit", "star" and "ring" connection schemes. When performing laboratory work, students have the opportunity to implement a large number of variants of network architectures built using PDH, SDH, ATM and Ethernet technologies.

Keywords: transport network, synchronous digital hierarchy, optical fiber, laboratory bench, flow.

2-KEY MECHANICAL KEYPAD WITH GRB LIGHTNING

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1. Introduction

This device is created as a separate controller for the computer. It has only two keys because for the purposes for which it will be used, more is not needed. The main design criteria's are: price, high response speed and small size of the devise. It was also decided to integrate RGB key lightning with several glow modes.

2. Main Part

As the main part of the device will be a microcontroller (MC). Because of this controller will be connected to a computer, the MC must be able to work as an HID device. There were several options for microcontrollers: ATMega 32u4, STM32, ATtiny 85. STM32 is the best MC from them in the price-performance ratio, but its performance is too high for our purposes, so the ATtiny85 MC was chosen [2]. It is the cheapest of the listed microcontrollers, but this MC has 8 KB of flash memory for the program, and only 6 pins, 2 of which will be used for USB interface. Two buttons will use two digital outputs of the MC, which means it is suitable for our purposes.

As a mechanical push-buttons were chosen Cherry MX switches, they are common and also have good durability.

For lightning will be used two WS2812B [1] LEDs, whey use only one digital pin for data transmission with microcontroller.

Initially, it was planned to make everything on one ATtiny85 microcontroller, implement key pressing on the computer by using hardware interrupts, and include the backlight control in the main loop, but this MC has one pin for hardware interrupts, which will not be enough for this idea. If program key pressing in main loop, this will significantly slow down the device's response to a keypress, so it was decided to install two ATtiny85 microcontrollers. One will be used only for the keypressing, the second - only for the RGB lightning.

It is necessary for the microcontroller to programmatically hold the key when it is pressed, and when the key is released, release it programmatically; this was implemented in the program code.

For a microcontroller, which is responsible for keystrokes, bounce suppression is optional, since all modern computers have a built-in anti-bounce system, however, for MC used for RGB backlighting, it is necessary

to exclude bounce, as this will lead to multiple changing the operating modes of the backlight with a single press. That is why this microcontroller's code has program method of bounce suppression.

All the necessary qualities of the device were taken into account in electrical diagram. The electrical diagram of the device is shown in Figure 1.
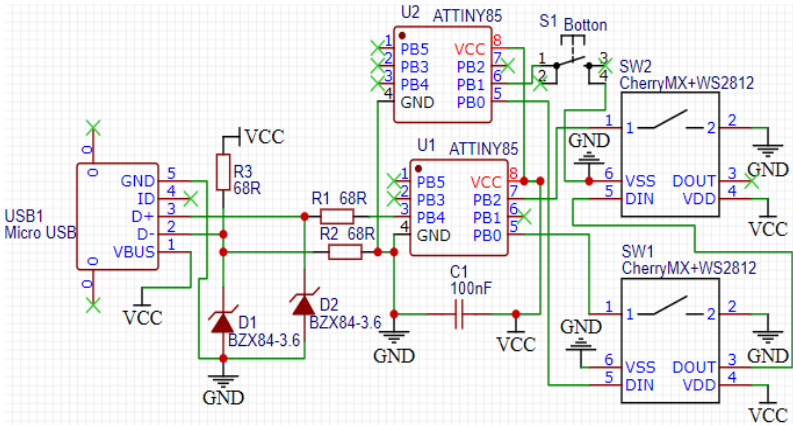
Figure 1 – Electrical diagram of the device

The device will be powered via USB from a computer, so where is no need to use stabilizers, only a power smoothing capacitor is installed. In addition, to increase the stability of the microcontroller, were installed two 3.6 V zener diodes on the USB + and USB- data bus. For the second MK, USB data bus stabilization is not applied.

To reduce the size of the device will be used SMD components. Also, it was possible to use USB type C instead of Micro USB, but it is much more expensive and difficult to install.

On the basis of the electrical diagram, was developed circuit board of the device. The top view of the circuit board on figure 2; and the bottom view - on figure 3.

Conclusion

Has been developed a controller device with Cherry MX mechanical push-button switches and with RGB backlighting with several lightning modes, which can be switched by a button. Response speed was minimized, and it is about several milliseconds. The size of the designed printed circuit board is 32,8mm x 48mm. The most expensive components are the mechanical switches, but they provide fast response time and long device durability. Also, in the future, it is planned to develop a software that will allow to reassign keys, create and change backlighting modes.
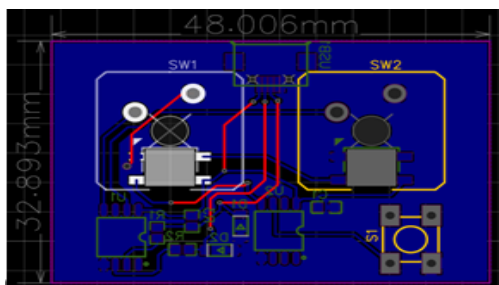
Figure 2 – The top view of the circuit board
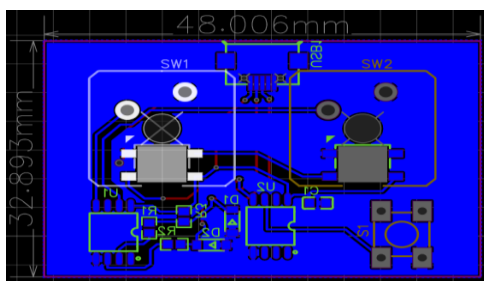
Figure 3 – The bottom view of the circuit board

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Аннотация. Микроконтроллер сочетает на одном кристалле функции процессора и периферийных устройств, содержит оперативное запоминающее устройство (ОЗУ) и (или) постоянное запоминающее устройство. Микроконтроллер — однокристальный компьютер, который выполняет относительно простые задачи. В работе представлено управляющее устройство для ЭВМ, которое выполнено на микроконтроллере и имеет две клавиши на механических кнопочных переключателях**.** Для уменьшения габаритов устройства используются SMD – компоненты.

Ключевые слова: микроконтроллер, процессор, печатная плата, шина данных.

Annotation. The microcontroller combines the functions of the processor and peripheral devices on a single chip, contains a random access memory (RAM) and (or) a permanent storage device. A microcontroller is a single-chip computer that performs relatively simple tasks. The paper presents a control device for a computer. It is made on a microcontroller and has two keys that are made on mechanical push-button switches. To reduce the size of the device, SMD components are used.

Keywords: microcontroller, processor, printed circuit board, data bus.

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BEAM-FORMING DEVICES OF THE PHASED ARRAYANTENNA OF THE 5G NETWORK BASE STATION USING MICROWAVE-PHOTONIC TECHNOLOGIES

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Introduction. Today, the development of phased array antenna (PHAAR) technology is associated with the improvement of their beam-forming devices (BFD). One of the promising areas of research is the design of BFD based on microwave-photonics devices, which is due to the following indicators:

— the ability to separate the web of antenna array emitters and the main module of the BFD due to fiber-optic tracks;

— increased electromagnetic isolation, due to the immunity of the optical fiber to external electromagnetic fields;

— the ability to combine fiber-optic and microwave components in a single structure;

—the possibility of forming the PHAAR BFD in the integral form together with the microwave part of the BFD.

Main part. The use of fiber-optic technologies for PHAAR control is extremely promising, thanks to the use of fiber fibreglass, which have low attenuation and mass, high flexibility, wide bandwidth and also immune to electromagnetic interference [1].

Modern telecommunications companies, such as Huawei, use BFD schemes in their developments with time delay control of signals at the inputs of primary PHAAR emitters [2]. This principle is called "*TTD beamforming*" (*true time delay*) — "diagram formation with fully time delays".

The use of analog fiber-optic communication lines (FOCL) components in the construction of BFD PHAAR involves the transfer of a microwave signal ("subcarrier") on the optical carrier, then the required optical signal processing, and then the reverse conversion to a microwave signal (detection) is carried-out.

The construction of hybrid transmission lines is carried out on the principle of IM-DD (Intensity Modulation — Direct Detection), which involves the modulation of the intensity of optical radiation and then direct detection of the processed radiation by the photodetector module. Figure 1 shows the BFD scheme for linear PHAAR, which has a prism-like structure that forms time delays [3] on reflecting Bragg gratings (BG). In this scheme, the optical splitter of 1×n divides the laser radiation. Further, in each channel, the optical carrier is independently modulated in intensity by microwave signals that are received by the PHAAR antenna elements. The modulated optical signals are then fed into the system with TTD modules.

Small delays are implemented in the "chirped" BG. Large delays are formed using discrete BG — with increase in the delay value when moving to the lower stages of the BFD. With the discrete BG structure, the discrete time delays of the modulated optical signals are performed. This means that the beam scan of the PHAAR radiation pattern (RP) will be discrete also. The number of formed PHAAR RP beams is given by the number of separate groups of resonant links formed in each of the BG.
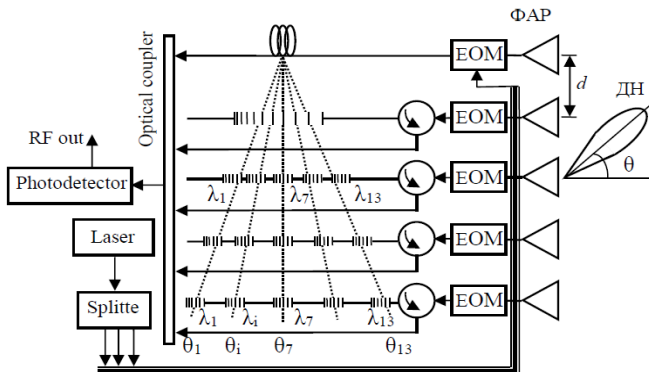
Figure 1 — The block diagram of BFD PHAAR with TTD modules based on Bragg gratings

After the TTD module, the radiation from all channels follows to the optical coupler, then to the photodetector. The photodetector recovers the microwave envelope (RFOUT) corresponding to the original microwave signal received by the PHAAR emitters from a certain direction θ. Switching the laser frequency leads to a shift in the position of the reflection points in the BG of the TTD module and, accordingly, to the proportional change in the time delays in each channel of the TTD module, that is, to the change of the PHAAR RP beam position.

In [4], a new optically controlled PHAAR and BFD is proposed, implemented on the basis of N independent phase shifters using a common single-band optical signal (OSSB), a polarizing modulator (PolM) together with N polarizing controllers (PC), N polarizing beam splitters (PBS) and N photodetectors (PD). The block diagram of this PHAAR is shown in Figure 2.
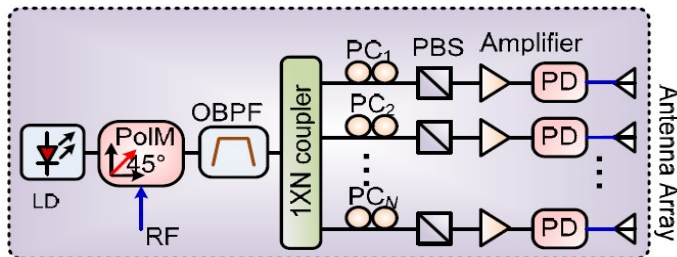
Figure 2 — The block diagram of PHAAR BFD [4]

When a microwave signal is applied to the PolM, a two-band modulated signal (DSB) is generated with additional phase modulation

along the two orthogonal axes of the PolM. The DC offset circuit of the PolM is controlled in such a way as to introduce a 90° phase difference between the two main axes of the PolM. The PolM is followed by an optical bandpass filter (OBPF) to remove one sideband, so a single-band signal with polarized modulation is generated. Next, the OSSB-polarized-modulated signal is divided into N channels using a 1×N coupler. Each channel includes one PC, PBS, and PD. The PC, along with the PBS, serves as a polarizer. When the direction of polarization of the polarizer is co-directed with one main axis PolM, the phase of the generated microwave signal on the PD is –90°, and if the polarizer is rotated to select an optical signal along the other axis of polarization, this phase changes by 90°. For other polarization directions, the phase shift is $2\alpha + 90°$ [5], where α is the angle between the polarizer's polarization direction and one main axis PolM. As a result, the phase shift can be independently and continuously adjusted from –180 ° to 180 ° by adjusting the PC setting before the PBS in each of the channels.

In [6] the PHAARBFD model, implemented on the basis of a fiber with chromatic dispersion (Figure 3), is considered.
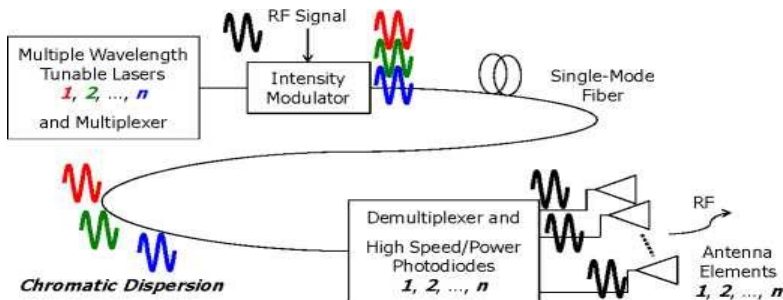
Figure 3 — The functional diagram of PHAARBFD[6]

Multi-wave optical signals emitted by multiple tunable optical sources (TLS) that overlap different wavelength ranges are combined into a single spectrum by wavelength division multiplexing (WDM) or optical coupler. Signals with multiple wavelengths are simultaneously modulated in intensity by a radio frequency signal in an electro-optical modulator.

After demultiplexing each wavelength, the optical signals via the photodetectors are converted into radio frequency baseband signals. When using separate optical fibers for separate wavelengths, the demultiplexer can be cut off. The RF signals are fed to the PHAAR emitters and provide the required RP. By controlling the TLS wavelength groups, the relative RF phase shifts at the emitters inputs can change due to the chromatic

dispersion of the fibers and, thus, the phase distribution of the field in the PHAAR opening changes and the main beam of the PHAAR RP is controlled.

Conclusion. Based on the review, the following conclusions can be drawn. The main approaches to the construction of microwave diagrams of BFD of phased arrays antenna, including those with discrete control of the radiation pattern, are analyzed. The analysis of the main methods of constructing the PHAAR BFD based on various radio-optical schemes is carried out.

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Аннотация. Проведён анализ существующих диаграмм ообразующих устройств фазированных антенных решеток с использованием технологий радиофотоники, описан принцип работы, достоинства и недостатки.

Ключевые слова: радиофотоника, устройство формирования луча, фазированная антенная решетка.

Annotation. The analysis of the existing diagram-forming devices of phasedarray antennas using microwave-photonics technologies is carried out, the principle of operation, advantages and disadvantages are described.

Keywords: microwave-photonic, beamforming device, phased array antenna.

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INVESTIGATION OF THE MICROWAVE-PHOTONIC BEAM-FORMING DEVICE OF THE PHASED ARRAY ANTENNA

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Introduction. Today, the active development of phased array antenna technology is associated with the improvement of their beam-forming devices (BFD), implemented on the basis of digital signal processing, aperture synthesis, and the hybrid microwave photonic topologies of BFD (MWP BFD).

The use of fiber-optic technologies atphased array antenna (PAA) development is very hopeful, since optical waveguide (OW) have low attenuation and mass, as well as high flexibility, wide bandwidth and unreceptive to electromagnetic fields [1].

Main Part. To construct the MWP BFD PAA, a summarized MWP BFD block diagram for linearPAA is developed. The BFD has an optical subsystem with prism-like structure of true-time-delays module based on irregular reflecting Bragg gratings (BG) that are selective for the number of optical carrier wavelengths [2]. Modeling of the characteristics of the receiving channel of the developed MWP BFD PAA is performed in the OptiSystem CAD, intended for system modeling of fiber-optic systems with analog or digital modulation.

The obtained model of the developed MWP BFD PAA receiving channel is shown in Fig. 1.

The scheme in Fig. 1 has 4 control points where measurements are made and the properties of the MWP BFD PAA receiving channel model are examined.

The simulation results are shown in Fig. 2-3. and in the Tables 1-3.
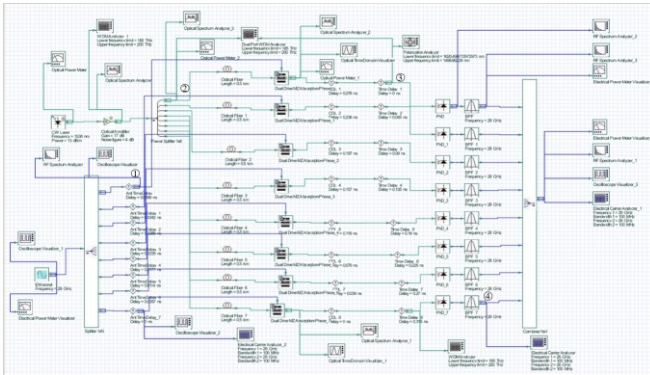
Figure 1 — Model of the receiving channel of
the MWP BFD PAA in CAD OptiSystem
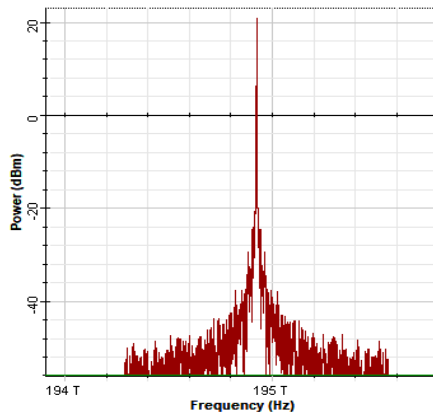
Figure 2 – Optical signal spectrum at the reference point 1

Table 1 – Data of the electrical carrier analyzer at the reference point 1

Frequency	Total Power	Signal Power	Noise Power	SNR
28 GHz	12 dBm	12 dBm	-100 dBm	112 dB
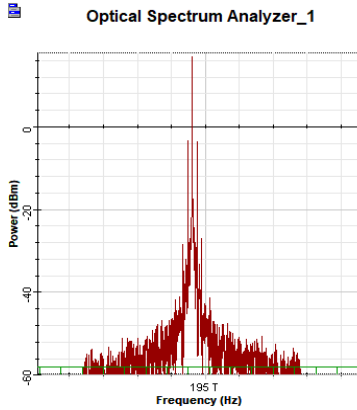
Figure 3 — Spectrum of the simulated optical signalat
the reference point 3

Table 2. Readings of the optical circuit analyzer switched on between
control points 2 and 3

Noise Figure (dB)	Input Signal (dBm)	InputNoise (dBm)	Input SNR (dB)	Input Noise 0.1nm (dBm)	Input OSNR (dB)
10.4	21	-46	67	-46	67
Output Signal (dBm)	Output Noise (dBm)	Output SNR (dB)	Output Noise 0.1nm (dBm)	Output OSNR (dB)	
17	-48	65	-48	65	

Table 3. Radio signal analyzer readings at reference point 4

Frequency	Total Power	Signal Power	Noise Power	SNR
28 GHz	0.6dBm	0.6dBm	-61.3dBm	62 dB

The developed MWP BFD model allowed us to evaluate the energy
characteristics of the system under development, the possibility of forming
the required amplitude-phase distribution of signals at the output of the
circuit isinvestigated.

Conclusion. Based on the results of the simulation, the system of
delay lines was calculated. The system of delay lines makes it possible to
form the necessary phase distributions. The output electrical signalsare
characterized by the high signal-to-noise ratios.The developed MWP BFD
model is functional and allows for highly efficient beam scanning of the
PAA radiation pattern.

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Аннотация. Разработана структурная схема радиофотонного диаграммообразующего устройства, обеспечивающего дискретное сканирование главным лучом диаграммы направленности фазированной антенной решетки. В САПР разработана модель передающего канала РФДОУ и проведена оценка энергетических характеристик системы.

Ключевые слова: радиофотоника, устройство формирования луча, фазированная антенная решетка.

Annotation. The CAD model of the microwave photonic topologyof phased array antenna beam-forming device that provides discrete scanning of the radiation pattern main lobe is developed. Studies of the energy and spectral characteristics of the circuit were carried out, which allowed to obtain the required amplitude-phase field distributions at the outputs of the antenna array.

Keywords: microwave photonic**,** beamforming device, phased array antenna.

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TV SIGNAL METERS

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Introduction.

The transmission of TV images, as well as information in general, is carried out in various ways in modern conditions,:

– through direct transmission by land;
– through cable networks;
– using satellite communications;
– using the global Internet.

Uninterrupted operation of technical equipment for transmitting, receiving, processing and TV signal and information storage are possible only if a certain signal level is maintained [8]. For these purposes, various devices are used, for example, TV signal meters, which allow not only testing the transmitted and received signals, but also improving the methods of their processing [5].

The TV signal meter is a device for setting up the receiving systems of satellite and terrestrial TV, as well as control over the level of received signals in cable TV networks. Such devices determine the absolute values of parameters and analyze the spectrum of input digital *DVB* signals, with the ability to record programs to an external storage device.

Materials and methods.

DVB signals are based on the compression standards of the category *MPEG (MPEG-2, MPEG-4, H.264…*) for the system level of information transmission networks, which are used to encode signals containing audio and video information, as well as to create elementary program and transport fluxes [2].

DVB signal standards for digital transmission of audio, video and data are divided according to the type of communication channels and for the first generation assume varieties:

– *DVB-C* (Cable Transmission, *ETSI* – European Telecommunication Standard Institute *EN 300429,* developed in 1996) – for cable TV broadcasting;

– *DVB-T* (Terrestrial Transmission, *ETSI EN 300744*, developed in 1997) – for terrestrial TV broadcasting;

– *DVB-S* (Satellite Transmission, *ETSI EN 300421*, developed in 1995 г.) for satellite television broadcasting;

– microwave multipoint distribution (*DVB-MS* mm-band systems operating at frequencies below 10 GHz; *DVB-MS* mm-band systems operating at frequencies above 10 GHz). *DVB-MS* systems belong to the class of cellular television systems [3].

A further development of the *DVB-T* standard is the digital TV broadcasting system for mobile terminals *DVB-H* (Handheld), and *DVB-SH* standard (Satellite Services to Handhelds), which is defined as a system that allows data transmission using IP (Internet Protocol) to personal terminals (mobile phones, *PDAs*) via satellite [4].

Most of the new generation television devices provide the operation with signals of the second generation of broadcasting standards, for example, *DVT-T2,* while retaining the possibility of evaluating (measuring) the parameters of analog television signals.

Devices for processing digital TV signals, including standards of the DVB category, are designed to measure the parameters of TV channels:

1) **with analog modulation:**

– voltage level of the image radio signal,

– the difference between the voltage levels of the radio signals of the image and sound maintenance,

– the ratio of the image radio signal to the noise in the frequency band of the image channel.

2) **with digital modulation:**

– the actual level of the radio signal voltage,

– the ratio of the digital TV broadcasting radio signal to the noise in the distribution channel [1].

The **TV signal meter** is a device that measures the magnitude and phase of an input signal at the same frequency within the IF bandwidth of the device. Modern TV signal meters use a superheterodyne receiver to down-convert a portion of the signal spectrum for analysis. The signal is converted to an intermediate frequency and then it is bandpass filtered and digitized [3]. In the fixed receiver mode, in contrast to the mode similar to the traditional spectrum analyzer, the bandwidth of the bandpass filter remains unchanged. The phase I and quadrature Q components of the signal are digitized.

Some of the tunings on a traditional spectrum analyzer are interdependent. To avoid measurement errors in general mode, modern spectrum analyzers bind these parameters to each other. That is, when you change one setting, all other dependent parameters will change automatically. But these parameters can also be set individually by the user. In this case, it is especially important to know the relationships and influences of the various tunings.

By using analog or digital *IF* filters, the maximum acceptable scanning velocity is limited by the transient durations in the *IF* filter and in the video filter. The duration of the transient in the video filter has no effect if the video bandwidth (*VBW*) is greater than the resolution bandwidth (*RBW)*. In this case, the transient time increases in inverse proportion to the square of the resolution bandwidth; therefore, with a decrease in the resolution bandwidth by *n* times, the minimum required sweep time becomes n^2 more.

If the video bandwidth (*VBW*) is less than the resolution bandwidth (*RBW*), the required minimum sweep time begins to be affected by the duration of the transient in the video filter. Similar to an IF filter, decreasing the filter bandwidth (*VBW*) increases the transient time in the video filter. A video filter, if implemented in analog form, is usually low pass filter of the 1st order or a simple *RC* network. Therefore, there is a linear relationship between video bandwidth (*VBW*) and sweep time. Reducing video bandwidth by *n* times increases sweep time by *n* times.

If the minimum required sweep time cannot be met, the *IF* filter or video filter is not be able to reach steady state, causing loss in amplitude detection and distortion in the signal display (frequency offset). For example, for a sinusoidal signal, neither level nor frequency will be displayed correctly. Moreover, the effective resolution may deteriorate due to the expanded display of the signal spectrum.

To avoid measurement errors due to short sweep times, *RBW, VBW*, and span are combined and interconnected in the normal operating mode of modern spectrum analyzers.

The resolution bandwidth automatically adapts to the selected span. Thus, long sweep times due to narrow resolution bandwidths at large spanning bandwidths or low resolution due to large one at small spanning bandwidths can be avoided. As a result, working with a spectrum analyzer becomes much easier. The coupling factor between span and resolution bandwidth can often be set by the user. With manual tuning it is possible to partially link these parameters, resolution bandwidths, video signal bandwidths and sweep time can be adjusted automatically.

Partial binding of these parameters is possible by means of manual tuning; resolution bandwidths, video signal bandwidths and sweep time can be adjusted automatically.

Also, spectrograms in the full *IF* range can be displayed on the display screen in the form of a set of discrete carriers or in the form of a continuous signal power distribution curve in a given frequency range by means of a TV signal meter. For example, on the horizontal axis of the spectrogram reference (frequency, MHz) in the detailed view mode, a portion of the spectrogram with a frequency domain of about 100 MHz can be displayed

on the screen, and the values of signal levels in dBµV can be plotted along the vertical axis within the range from 37 dBµV to 92 dBµV.

For a *DVB-T2* channel, the bit error rate BER in a digital stream is measured by analyzing the operation of the *LDPC* decoder (*BER* before the *LDPC* decoder) and the BCH decoder (*BER* after the *LDPC* decoder and the packet error counter after the *BCH* decoder). The impulse response of the *DVB-T2* channel is read by a demodulator. The measurement of the voltage level of the radio signal is carried out using an Analog-to-digital converter, *ADC,* after the peak detection of the signal from the output of the logarithmic one of the amplifier of the third IF of the device. The operating principle of the spectrum analyzer is based on a sequential analysis method with a spectrum indication on a PC display.

In the mode of measuring the parameters of the reception quality of *DVB-T2*, the digital values of the measured parameters are displayed: *MER, BER* before the *LDPC* decoder, *BER* after the *LDPC* decoder, the number of erroneous packets after the *BCH* decoder. In the CD measurement mode, the display shows a graph of the quadrature components of the demodulated signal on the amplitude-phase plane. In the impulse response measurement mode, a graph of the dependence of the levels of signals arriving with a delay relative to the main signal is displayed, depending on the value of the delay. In the mode of measuring the level of the radio signal at the frequency point, for TV signals with analog modulation, the digital value of the voltage level of the radio signal, the ratio of the levels of the video and audio carriers and the ratio of the level of the image carrier to the noise are displayed, and for signals with digital modulation the value of the actual level of the voltage of the radio signal [2, 3].

These devices can search for channels on a selected transponder, according to a group of transponders united in a broadcasting network, or in a "blind" search mode with automatic detection of broadcast parameters [7].

The block diagram of the analyzer is shown in Fig. 1.

The diagram shows how the input signal amplified by a broadband amplifier or attenuated by an attenuator, if necessary, after a low-pass filter *(LPF)* or attenuated by an attenuator (A), is converted into a signal of the second intermediate frequency 39 MHz in the level measurement mode or 36.125 MHz in the demodulation mode of *DVB-T* and *DVB-T2* signals using a TV tuner with double frequency conversion (*DFC*). The signal of the second intermediate frequency is converted in the mixer (*M*) into a signal of the third intermediate frequency by means of heterodyne *(G)* of 28.3 MHz and is filtered at a frequency of 10.7 MHz by a filter (*LIF3*), which determines the bandwidth of the receiver. The signal of the second intermediate frequency after filtering in a filter (*FFC2*) is fed to the *DVB-T* /

T2 demodulator (*CD*) in the mode of demodulation of channels with digital modulation *DVB-T* and *DVB-T2*, where demodulation and measurement of signal parameters are carried out.
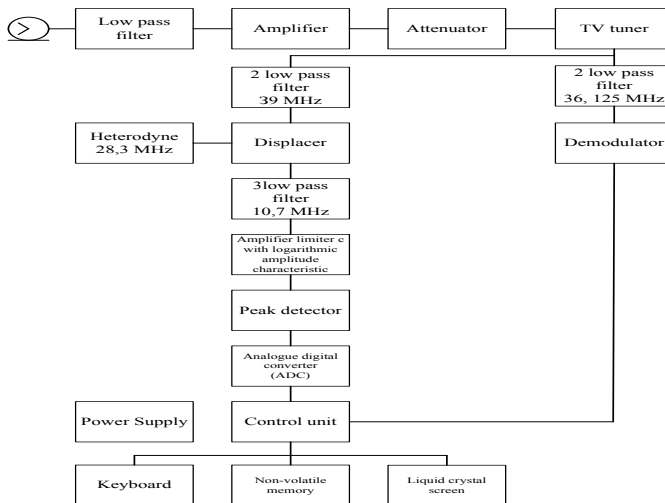
Figure 1 – Block diagram of the TV signal spectrum analyzer.

The amplifier-limiter with a logarithmic amplitude characteristic (*ALAC*) implements the logarithm and detection of the radio signal. A peak detector *(PD)* allows using an analog-to-digital converter (*ADC*) to measure the level of the image carrier. The digital code of the logarithm of the peak level of the input radio signal is normalized as an actual value and is corrected by the microcontroller of the control unit (*CU*) taking into account the calibration table [6].

In the mode of demodulation of channels with digital modulation *DVB-T* and *DVB-T2,* the signal of the second intermediate frequency after filtering in a filter (*FFC2*) is fed to the *DVB-T / T2* demodulator (*CD*), in which demodulation and measurement of signal parameters are carried out. The measurement results are processed by the control unit.

The control unit receives operator commands entered from the keyboard, converts data and displays them on a liquid crystal or graphic display (*LCD or GD*), as well as works with an external PC. The nonvolatile memory (*NVM)* device stores the calibration coefficients defined at the manufacturing plant, the "notebook" data and service information. The power supply unit *(PSU)* generates voltages from batteries or an external power source.

Results and conclusion.

The principles of operation of TV image signal meters are considered, which can be used when setting up and installing TV transmitting and receiving equipment, as well as for creating appropriate devices for both spectral and vector signal analysis. Spectral analysis and vector analysis are performed with specialized software.

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Аннотация. На основе требуемых параметров для анализа и измерения ТВ сигнала, были описаны технологии создания необходимых для этого приборов. Проанализированы методы и основные принципы создания подобного оборудование. Рассмотрены некоторые области и направления их применения.

Ключевые слова: ТВ сигнал, анализ, измерения, сети передачи информации, анализатор сигналов, прибор.

Annotation. The technologies for creating the devices required for this purpose on the basis of the parameters for the analysis and measurement of the TV signal, were described. Methods and basic principles of creating such equipment are analyzed. Some areas and directions of their application are considered.

Keywords: TV signal, analysis, measurements, information transmission networks, signal analyzer, device.

INVESTIGATION OF THE POSSIBILITIES OF USING RADIO MODULES OF THE 2,4 GHZ BAND FOR ORGANIZING A RADIO NETWORK BASED ON SMALL-SIZED MOBILE PLATFORMS

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Introduction

The purpose of this study is to identify the real technical features and possibilities of using the nRF24L01 + PA + LNA radio module for organizing a radio network based on small-sized mobile platforms, which can include both drone and various vehicles for use inside and outside buildings.

The issues of organizing continuous communication within a group of radio modules, as well as experimental determination of the range and stability of communication, are considered.

Main part

To organize a radio network, the nRF24L01 + PA + LNA module was chosen, which has the following technical features [2]:

- 2,4 GHz ISM band operation;
- 126 RF channels, with a channel width of 1 MHz;
- Air data rate: 250 kbps; 1 Mbps; 2 Mbps;
- Programmable output power: -18, -12, -6, 0 dBm;
- 82 dBm sensitivity at 2 Mbps;
- Antenna gain: 2 dBm;
- 1,9 to 3,6 V supply range;
- Maximum current consumption 12,3 mA (at 2 Mbps).

The amplifier (LNA) and the power amplifier (PA) are connected to the antenna by means of a duplexer, which separates the two signals and prevents the sensitive input of the LNA from being overloaded relative to the powerful PA. The use of the built-in power amplifier of the radio transmission path and the low-noise amplifier of the radio receiving path allows to achieve stable communication at a distance of more than 1 km within the line of sight. The block diagram of the module used is shown in Figure 1.
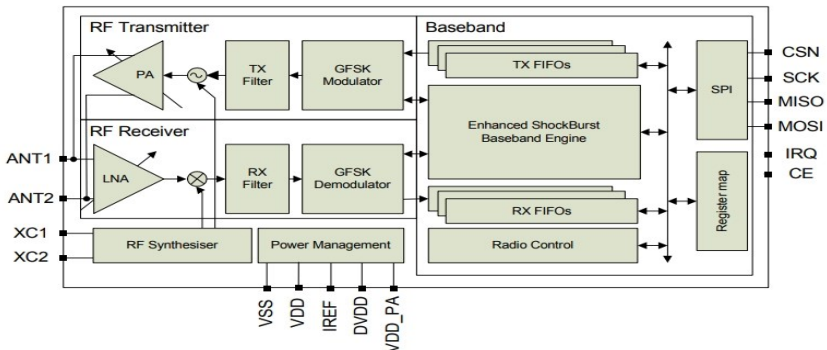
Figure 1 — nRF24L01 block diagram [2, p. 9]

At the same time, a group of 6 transmitting and 1 receiving devices can be assembled in one channel. The presence of 126 channels for communication allows to choose the least "noisy" for better and more reliable communication. The connection between the modules is half-duplex, which allows to organize a significant network by combining small subnets [1].

The radio network elements were tested in various environments: in a park area and in an open space (Figure 2), as well as in a multi-storey building (Figure 3).
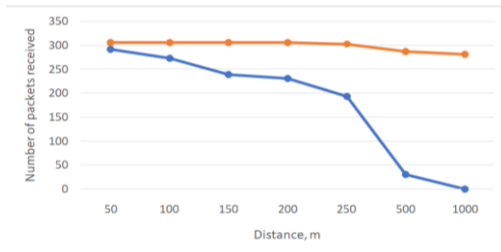
Figure 2 — The dependence of the received packets on the distance in the conditions of the park area (blue), open territory (orange)
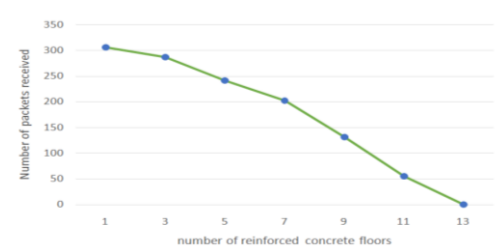
Figure 3 — The dependence of the received packets on the number of reinforced concretes between the modules

The finished working devices of the radio network are shown in Figure 4.

Figure 4 — Finished working device

The transmitting device sends 306 packets (signals) in 2 seconds. This number of packets is due to the software feature of the selected microcontroller. The data was transmitted at a maximum power and transmission rate of 250 kbps. The receiving device outputs the number of received packets to the 4-bit TM167 display module. The settings of the receiving device are similar to those of the transmitting device.

Conclusion

A study of the quality of communication, depending on the surrounding area, shows that the radio module under study works best in an open space, and worst of all in a multi-storey building. The attenuation of the signal is due to the fact that the wave does not pass through concrete floors, but re-reflects from obstacles and falls from one floor to another through window and door openings. In open areas, the quality of communication remains at a high level — 90% at a distance of more than 1 km.

Note that the radio network will be used to control mobile platforms operating as part of the swarm. Mobile platforms allow to configure the network in such a way that the number of reinforced concrete partitions will be minimized. Due to this, the quality of communication in a multi-storey building can be improved to the values corresponding to the open space.

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Аннотация. Рассмотрен принцип построения радиосети для управления мобильными платформами на базе модуля nRF24L01+PA+LNA и вычислительной части в виде *Arduino Nano*. Приведена структурная схема исследуемого модуля. В процессе проведения испытаний определены зависимости качества связи модулей от среды тестирования. Сконфигурирована работоспособная сеть из нескольких устройств. А также представлено фото готовых модулей.

Ключевые слова: Радио модуль; NRF24L01; *Arduino*; радиосеть на базе мобильных платформ; радиосвязь.

Annotation. The principle of building a radio network for managing mobile platforms based on the nRF24L01+PA+LNA module and the computing part in the form of an Arduino Nano is considered. A block diagram of the module under study is given. During the testing process, the

dependencies of the communication quality of the modules on the testing environment are determined. A workable network of multiple devices is configured. There are also photos of ready-made modules.

Key words: Radio module; NRF24L01; Arduino; radio network based on mobile platforms; radio communication.

EXPERIENCE IN USING PHOTOGRAMMETRY TO CAPTURE ARCHAEOLOGICAL SITES AND OBTAIN DRAWINGS BASED ON CREATED 3D MODELS

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Introduction. The development of the tourism industry is one of the priority directions of the socio-economic development of the Republic of Crimea and the city of Sevastopol [1]. The region has a wide variety of cultural heritage sites, including archaeological sites, which are attractive for external and internal tourism.

However, in addition to attracting tourist flows to the region, such tasks as the search, preservation and revival of lost objects of historical and cultural heritage, as well as the opportunity to demonstrate them to the public, which can help create 3D models, are relevant.

3D models of objects can also be used not only as content provided with the help of augmented and virtual reality technologies, but also can help in the work of archaeologists when fixing finds at the stage of excavation, as well as for the further formation of reporting documentation.

Analysis of existing methods. According to the Regulations on the procedure for conducting archaeological field work and compiling scientific reporting documentation [2], photographic recording of an object of archaeological heritage fully and accurately conveys the features of the relief and the topographical situation. However, a single photographic record does not exempt archaeologists from the need to maintain technical documentation by means of drawings (plans and sections of excavations, stratigraphic profiles, etc.), performed directly at the work site on paper or in electronic form with maximum accuracy of reproducing details.

Based on the requirements for reporting documentation and observations of the course of excavations, it can be argued that the three-dimensional fixation and design of drawings based on the results of the

excavation is the most time-consuming process in the design of scientific documentation. In addition, it is worth paying attention to the so – called "human factor" that affects the accuracy of the image of the find or excavation – the quality of the sketch (sketch) – which makes the resulting image not the most reliable source. All these factors not only «slow down» the process of archaeological excavations itself, but also require a large amount of time and resources. This means that the task of modernizing the process of fixing archaeological objects with the introduction of modern information technologies is urgent.

3D modeling is the process of creating a three-dimensional graphic object, for the purpose of its further use to create an image of an object or as a copy of an existing one. One of the most important areas of 3D modeling is the construction of three-dimensional models of architectural monuments. 3D models of objects obtained with the help of modern auxiliary tools can be digital counterparts of real objects. To create three-dimensional models, various technological solutions can be used, one of which is the photogrammetric method.

Experience in using the method of near-field photogrammetry to record archaeological finds and the stages of work carried out at the excavation site using the "standard". Photogrammetry is a method of three-dimensional measurements that uses the central projection as the main mathematical model as a way to obtain an image [4].

For example, a fragment (square) of the excavation of a rural estate of land plot №102 on the territory of Ancient Chersonesos was taken. At the first stage of the work, a series of images of a part of the excavation site, square №10, was created.

In order to accurately indicate the scale ruler in the drawing in the future, when creating a series of images, a measuring rail was placed near the selected object as a "reference", which archaeologists use during excavations (see Figure 1).

Figure 1 – A series of photos of the excavation of square №10

After uploading the photos to the system, the parameters of the external and internal orientation of the cameras were determined using the Agisoft PhotoScan program, i.e. the common points of the photos were found, and then all the parameters of the cameras were determined using them: position, orientation, focal length, (see Figure 2).
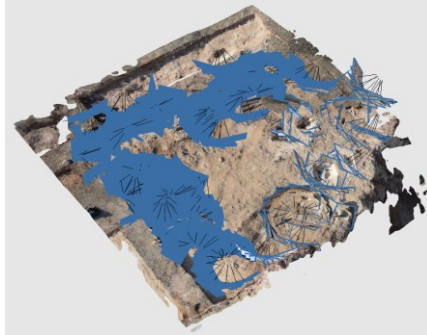
Figure 2 – Align photos, get camera position and orientation data, and determine matches

The results of this stage of processing were sparse point clouds in the 3D space of the model (see Figure 3).

Figure 3 – Sparse cloud of common points in the 3D model space

This was followed by the construction of dense point clouds based on the camera positions calculated at the first stage of processing (see Figure 4).

At the third stage, three-dimensional polygonal models were constructed that describe the shape of an object based on dense point clouds. For the simulation, it is determined that an arbitrary surface type will be reconstructed, since it is assumed that closed surfaces are being constructed. The Agisoft PhotoScan program allows you to build wireframe, shaded and solid models, Figure 5.

Figure 4 – Dense point cloud

The next step is texturing the models to give them a realistic look, Figure 6. This is achieved by creating textures from existing sets of photos.
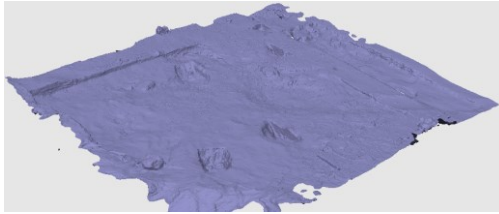
Figure 5 – Solid polygon model

Figure 6 – Textured model

Thus, it can be noted that the main advantages of this method of creating 3D models are its versatility in application for objects of various complexity. In addition, the obvious advantage is that any owner of a camera or smartphone can create such a series of photos, if their technical characteristics allow you to configure the parameters of photographing that meet the requirements of the selected program. However, it should also be noted that processing a large number of photos requires high-performance equipment, which can lead to the fact that this method may not be effective for creating digital doubles of complex objects.

Creating drawings based on the resulting 3D models. At this stage, the resulting model can be used for archaeological research without the

participation of a real object, but there is still an unresolved problem of creating drawings, the creation of which is one of the most time-consuming processes in the design of scientific documentation based on the results of excavations. You should also keep in mind the "human factor" that affects the accuracy of the output image (drawing).

Thus, after creating a 3D model, you need to use special software to create terrain profiles and other objects (archaeological finds). There are several software products that are suitable for the above-mentioned purposes in terms of their functionality. Evaluating the effectiveness of their use requires additional research, since various solutions can be selected depending on the different quality criteria of the profiling results. A detailed comparative analysis of such software solutions will allow you to choose the most optimal option for the method of creating profiles of archaeological objects and terrain.

Figure 7 shows an example of a ready-made terrain profile of square №10 of the excavation of a rural estate of land plot №102 on the territory of Ancient Chersonesos.
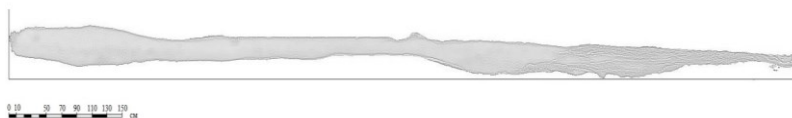
Figure 7 – Terrain profile of square №10 with a scale ruler

Conclusion. The collection of 3D models created by the method of near photogrammetry will not only increase the bank of digital copies of archaeological finds, which, in addition, can be used as content for creating applications with augmented and virtual reality, but also serve as a basis for improving the quality of the description of the results of archaeological work. The use of modern technologies for three-dimensional fixation of archaeological surveys makes it possible not only to simplify and speed up the process of fixing finds and terrain, but also to increase the accuracy of the resulting drawings in the required projections, which can later be used to compile scientific reporting documentation.

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Аннотация. В данной статье рассмотрены аспекты трехмерной фиксации археологических объектов с применением современных информационных технологий, также описана работа по созданию 3D-моделей в программе AgisoftPhotoScan, приведен пример создания точной модели раскопа сельской усадьбы земельного надела №102 на территории Древнего Херсонеса, описан процесс по созданию чертежей археологических объектов, приведен пример создания чертежа находки для дальнейшего его использования в создании отчетной документации.

Ключевые слова: цифровые технологии, 3D-моделирование, фотограмметрия, археологические работы, трёхмерная фиксация.

Annotation. This article discusses the aspects of three-dimensional fixation of archaeological objects using modern information technologies, also describes the work on creating 3D models in the Agisoft PhotoScan program, provides an example of creating an accurate model of the excavation of a rural estate of land plot № 102 on the territory of Ancient Chersonesos, describes the process of creating drawings of archaeological objects, provides an example of creating a drawing of a find for further use in creating reporting documentation.

Keywords: digital technologies, 3D modeling, photogrammetry, archaeological work, three-dimensional fixation.

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KEY CYBER THREATS OF 2020 ACCORDING TO CISCO

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Introduction. The pandemic and remote work have made effective information security tools more relevant than ever before. Organizations have had to rapidly protect and scale remote access tools against the backdrop of increased cybersecurity risks. Against this background, Cisco identified the main trends of 2020 in the field of information security and gave recommendations as for what to focus on in 2021.

The main part. Trend 1: Strengthening Healthcare.

In 2020, the health sector became a critical point in the field of information security against the backgroundof the outbreak of the pandemic. The risks here are particularly high, because medical IT systems are the basis of the moderncare of patients, and human life depends on their security.

Outdated technologies have become a huge problem. Doctors and healthcare institutions are constantly weighing the risks of introducing new IT technologies and devices that may be insufficiently protected, comparing them with the risks of preserving legacy technologies that do not correspond to the latest achievements of medicine. Ultimately, communicating cybersecurity procedures to every healthcare professional is vital. In medicine, the consequences are not limited only to information losses.

It is relevant to note that the Cisco 2021 Global cybersecurity report Security Outcomes Study, prepared by 4,800 IS, IT and privacy professionals from 25 countries, confirmed that effective collaboration between IS- and IT-services in the health sector increased the ability of organizations to avoid serious incidents by an average of almost 16% and minimize unplanned and resource intensive work by an average of 20%.

Trend 2: Protecting Connections when Working Remotely [2,5].

The transition to remote work in 2020 meant:

• First, that all employees should be able to work safely from home,

• Second, that they retain access to all necessary corporate resources.

Therefore, many employees turned to Remote Desktop technology, which allows the user remotely connect to a computer. On the one hand, the work computer appears to be at the employee's home, but on the other hand, the RDP protocol often creates cybersecurity problems.

These issues include identity theft, man-in-the-middle attacks, and remote code execution. Any remote desktop solution, in case of a compromise, provides an attacker with access to the resources of the organization. Companies that use the RDP protocol must take additional

security measures to protect themselves and their employees. At the same time, Cisco notes a number of key points:

• Do not use RDP directly over the Internet. First, you need to establish a VPN connection through which employees can securely access the necessary resources using the RDP protocol.

• Use multifactor identification.

• Block access after a reasonable number of unsuccessful attempts.

Trend 3: Securing Personal Information.

The Cisco 2021 Data Privacy Benchmark Study demonstrated that the importance of privacy has grown during the pandemic. Among the information security professionals who took part in the survey, more than a third state that data privacy is one of the main areas of responsibility along with risk assessment and management, as well as responding to threats. Moreover, more than a third of organizations investing in personal data protection receive benefits that are at least twice the amount invested [1, 3].

The average annual data protection costs in the Russian organizations that participated in the survey were about $ 1.4 million.

The benefits that their companies received as a result of increased data protection measures the Russian respondents estimated at $2.1 million per year.

Respondents from Russia assert that the benefits of implementing data protection technologies twice the investment.

Trend 4: Updating Ransomware Programs.

In 2020 attacks on corporate networks through ransomware programs were characterized by new tactics. For example, cybercriminals began to build countdown timers into ransomware, threatening to permanently destroy data or launch a Big Game Hunting attack.

In such an attack, cybercriminals use the infected system as a springboard for further access to the network. Additional systems are captured from it, while the privileges of criminals are extended. Actually, the ransomware is only activated after all systems have been infected in order to inflict maximum damage [4, 5].

Mailing lists with advertisements for sale have become more frequent, in which criminals sell other cybercriminals access to various networks. In addition, they are now using "double blackmail": large amounts of corporate data are stolen before the ransomware launches, and victims have to not only restore compromised networks, but also eliminate the threat of disclosure of intellectual property, trade secrets and other confidential information.

According to the Cisco 2021 Security Outcomes Studyreport the success of security programs is promoted by:

1. Proactive updating of information security technologies – before they become obsolete,

2. Ensuring good integration of information security technologies, including a wide range of third-party solutions.

These practices increase organizations' chances of achieving concrete results, such as creating a strong corporate culture of information security, recruiting talented security personnel, or maintaining the profitability of an information security program.

Other methods that have a positive impact on achieving the desired results in the field of information security include accurate threat detection, timely response to incidents, and effective use of automation. Zero-trust compliance and a thorough inventory of assets are also important factors in the success of cybersecurity, as it is impossible to truly secure what you do not suspect.

Trend 5: Hunting for Passwords.

According to the Verizon 2020 Data Breach Investigations Report, identity theft ranks second among the most common actions of hackers. And this is very serious, because using legal passwords, cybercriminals can gain access to the entire network without being noticed.

Trends are similar to the use of ransomware: the identification data that cybercriminals "pump out" using the credential dumping technique is used for future attacks. In operating systems, they can be stored in memory, in databases, or in configuration files. Attackers can easily copy passwords after entering computers and obtaining identification data.

How to prevent identity theft:

• Monitor access to the databases of the LSASS (Local Security Authority Subsystem Service) authentication service and the SAM (Storage Area Management) storage environment management system [6].

• Track command-line arguments used in credential dumping attacks.

• Analyze logs to detect unplanned activity on domain controllers.

• Detect unexpected and unassigned connections from IP addresses to known domain controllers.

Conclusion. In 2020, there was a massive surge in the number of threats, the reasons for which could be both the acceleration of digital transformation in all industries, and the widespread transition to remote work. During the year, the number of cyberattacks grew, their complexity increased, and it became increasingly difficult to resist them. Cisco regularly publishes researches that analyze current threats and provide recommendations for countering them. The reports presented at the end of 2020 contain comprehensive information about current risks, as well as recommendations for protecting against cyberattacks. Based on this

research, companies can boldly implement digital transformation plans and build a reliable and secure IT infrastructure.

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Аннотация. В этой статье рассматриваются исследования Cisco, американской транснациональной компании, разрабатывающей и продающей сетевое оборудование, предназначенное для крупных организаций и телекоммуникационных предприятий.Специалисты компании Cisco проанализировали наиболее заметные тренды в сфере защиты данных и информационной безопасности, влиявшие на ландшафт угроз в прошлом году. Среди них — активное развитие программ-вымогателей, атаки на пользователей RDP, угрозы, с которыми столкнулась система здравоохранения, и другие факторы. Cisco регулярно публикует исследования, в которых анализируются текущие угрозы и даются рекомендации по их противодействию. Основываясь на этих исследованиях, компании могут смело реализовывать планы цифровой трансформации и строить надёжную и защищённую ИТ-инфраструктуру.

Ключевые слова: исследование Cisco, тенденции информационной безопасности, здравоохранение, удаленная работа, персональные данные, программа-вымогатель, «охота на пароли».

Annotation. This article examines the research of Cisco, an American multinational company that develops and sells network equipment designed for large organizations and telecommunications enterprises. Cisco experts analyzed the most notable trends in the field of data protection and information security that affected the threat landscape in the last year. Among them are the active development of ransomware, attacks on RDP users, threats faced by the healthcare system, and other factors. Cisco regularly publishes research that analyzes current threats and provides recommendations for countering them. Based on this research, companies can boldly implement digital transformation plans and build a reliable and secure IT infrastructure.

Keywords: Cisco's research, information security trends, healthcare, remote work, personal information, ransomware, password hunting.

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ANALYSIS OF COMPUTER VISION TECHNOLOGIES IN THE FIELD OF FACE RECOGNITION IN A DIGITAL VIDEO SIGNAL

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At the moment, the development of the idea of artificial intelligence in general and computer vision in particular has a high level of relevance. In addition to the general need for the development of the presented technologies to achieve scientific and technological progress, the consequences of the spread of the coronavirus infection Covid-19 also influenced the relevance. All over the world, it became necessary to use technical means to identify infected people with minimal consequences, which prompted the development of these technologies. Also, due to the need to comply with quarantine measures, most people were forced to work

from home, which forced to make adjustments and improve interaction through video conferencing.

Therefore, at the moment, many companies are involved in the development of artificial intelligence technologies, providing their own solutions to the problems posed in this area. Consider the most famous solutions implemented by various companies based on the scope and range of tasks [2, 7].

Google offers these solutions:

- AutoML Vision – a solution used to train machine vision systems based on Google's image recognition technology;

- Vision API – allows you to analyze images and contextual data using a self-learning machine learning model (in REST API);

- Video Intelligence - the project provides an interface that allows automatic recognition and search of objects within the video sequence. The API is able to detect when an object corresponding to a certain word appears on the screen, as well as register frame changes.

Apple offers the Vision Framework technology. It performs face, text, barcode recognition and image classification. Also allows you to use custom Core ML models for classification or object detection.

NVIDIA Company offers its solution to this issue, namely – NVIDIA DIGITS technology. It allows you to interactively manipulate data and train models, classify images, recognize objects, and segment images.

Amazon presented the technology Amazon Rekognition, which is able to recognize objects, scenes, text, people and specific actions in images and videos, as well as identify inappropriate content. Amazon Rekognition analyzes faces with high accuracy and provides powerful face search capabilities that can be used to detect, compare, and analyze faces in a variety of use cases that require user verification, people counting, and public safety.

IBM is developing Watson Visual Recognition technology. It relies on image analysis to identify objects, environments, faces, and other materials. Also allows you to create and train custom classifiers using the existing image database.

Intel implements Intel Vision Technology, which is used to generate inference. It provides advanced visual analytics capabilities – from camera to cloud.

Facebook uses Facebook Computer Vision technology. The system analyzes photos to find similar faces, determine the area of interest and other user data, in order to select the right people to meet and display personalized ads.

Baidu uses a technology of the same name, which analyzes images in order to determine the interests of the user and display personalized ads, as well as to display images that respond to a user's search query.

Microsoft offers several solutions to this problem at once:

- Computer Vision API – designed for the intelligent use of images and face detection, character recognition and classification. Computer vision detects people's faces in the image and creates a rectangle for each of them, and also indicates age and gender;

- Bing Visual Search – allows users to perform image searches and get analytics.

Tobii Group uses TobiiDynavox technology. It is an eye-tracking (hands-free device control) technology designed primarily for people with disabilities.

SeeStorm uses SeeVoice technology. This is a software product for creating synthetic video in real time (creating synthetic avatars from the user's front cameras for Internet applications).

SenseTime has developed a face recognition system. To implement it, it uses artificial intelligence systems to quickly analyze the image from cameras and identify the identity of the person who is in the frame.

Yitu also offers several computer vision technologies:

- Yim Dragonfly Eye – intelligent security system – ensuring city security, transport and intelligent financial functions;

- Smart Healthcare – provides assistance with examination and detection of diseases and diagnostics using image analysis;

- City Data Hub is a solution for optimizing urban transport management.

Summary, at the moment, with the help of computer vision technologies, a wide range of tasks in the field of face recognition is being solved: from analyzing the image and verifying it with personal data of the person to analyzing the video sequence and detecting and recognizing faces in real time. In this article, we will look at the latest technology in this scientific field.

Computer vision is a scientific field engaged in research in the field of automatic fixation and various kinds of image processing (detection, tracking, identification) using computing devices; it is a system of solutions that find, track and classify objects [1]. Modern high-performance computing devices, memory becoming cheaper every year, high-quality cameras and high bandwidth of information transmission channels make it possible to achieve significant results in this area, especially in connection with the latest research in the field of machine learning and, in particular,

neural networks. Let's take a closer look at some of the computer vision technologies.

A review of literary sources showed that since the development of artificial intelligence technologies is a science-intensive and expensive process, it is carried out by commercial companies presenting their solutions for certain problems. Face recognition using artificial intelligence systems at this stage of technology development is widely used to catch criminals in the United States and China. For example, the SenseTime company has been developing face and image recognition systems for working with large amounts of data since 2014. SenseTime is working with the Chinese police to help track down criminals among large crowds. SenseTime uses artificial intelligence technology to quickly analyze camera images and identify the person captured by the camera. The software developed by SenseTime is embedded in a large number of mobile devices, and if a person was photographed on a Chinese-made smartphone or on the street of a Chinese city, then he most likely got into the surveillance system [6]. Megvii Technology uses the Ministry of Public Security's database of nearly 1.3 billion legal identified files of Chinese citizens to scan faces. [6] China-based YITU Technology's products and services include Yitu Dragonfly Eye smart security system (machine vision-based system for city security, smart transportation and smart financial functions), City Data Hub (solutions for optimizing urban transport management) and Smart Healthcare (aids in disease screening and imaging diagnostics). The company also manufactures intelligent equipment that allows computer systems to "see", "hear" and "understand" what is happening in the environment [2]. China Merchants Bank uses Yitu's facial recognition technology at more than 1,500 of its retail locations. The company has developed China's first intelligent medical imaging platform that is capable of providing detailed diagnostics of screened patient data.

Among the latest developments in the area we are considering, Amazon has introduced the Amazon Rekognition service, which allows you to embed video and image analytics created by algorithms based on deep learning into applications [5]. The system is able to recognize the environment, people's faces, their actions, objects, and detect prohibited scenes of violence. Rekognition enables real-time, parallel face searches across multiple data stores containing hundreds of millions of faces. The service then conducts a quick search on it to find faces that are visually similar to the faces of people in the video or photo. The corporation has also signed contracts with police forces in several counties and states as the company positions Rekognition as an effective real-time facial recognition tool, including video feed from wearable cameras on police uniforms.

Microsoft also offered its face recognition technology solution. She introduced Cognitive Services Azure, which includes face detection, among other features. The service allows you to identify faces and their attributes in the image. Identity identification allows you to find a match with a specific person in a private repository where the data of a maximum of 1 million people is stored. The emotion recognition system detects various facial expressions such as joy, disgust, indifference or fear. The software tool allows you to detect and group images of faces with similar features [4].

Russian companies have also contributed to the development of computer vision technologies for face recognition, in particular. NtechLab provided FindFace technology for the government and various business sectors [3]. The technology is used as a web service that facilitates the search for people by their photographs on the VKontakte social network. The algorithm behind NtechLab's solutions has been shown to be more effective in identifying those who violate quarantine, monitoring social interactions between potentially infectious people and promptly notifying the appropriate supervisory services.

Another Russian technology for human face recognition using computer vision is the VisionLabs LUNA platform from VisionLabs and SAP Labs CIS [8]. Initially, the platform was used to meet the needs of banks. The range of tasks it solved included face recognition in a video stream and its correlation with the bank's database for user verification in the Internet bank. With the development of this technology, the range of tasks has expanded and at the moment VisionLabs LUNA is based on the pattern recognition technology, which is officially one of the three best in the world in terms of recognition quality in real conditions. The solution is focused on processing photo images and streaming video. It includes the functions of face detection and tracking, quality assessment, extraction of key points of the face and encoding them in the form of a unique compact descriptor. The system is capable of analyzing images or frames from video and detecting human faces that meet a user-defined set of parameters - for example, face size, face rotation angle, or image quality. Face descriptors require much less system memory than images. VisionLabs is one of the first companies to develop and implement a face identification and verification system using convolutional neural networks (CNN) into commercial products.

Therefore,after analyzing computer vision technologies in the field of face recognition in a digital video signal, we can draw several conclusions:

– the development of solutions in this area is carried out by commercial companies, since the development process itself is resource and science intensive;

– in the literature there is mainly a description of the result of the application of technologies, and not a description of the face recognition process, since this information is a trade secret;

– most companies not only provide their technologies as a service for third-party services and applications, but also cooperate with law enforcement agencies in the field of catching criminals;

– the development of technologies that recognize a human face is being actively pursued and does not lose its relevance due to the wide field of application of its results and the possibility of commercialization.

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Аннотация. В статье рассмотрены возможности применения искусственного интеллекта в области распознавания человеческого лица в цифровом видеосигнале. Приведены результаты литературного обзора технологий компьютерного зрения в рассматриваемой области. Также проведен анализ актуальности развития технологий

распознавания человеческого лица в цифровом видеосигнале. Поскольку данное направление является актуальным, мы рассмотрели спектр для применения технологий распознавания человеческого лица в различных областях деятельности. В статье представлен обзор существующих решений, предоставленных коммерческими компаниями со всего мира и примеры их практического применения.

Ключевые слова: искусственный интеллект, технологии распознавания лица, компьютерное зрение, распознавание объектов, коммерческое применение.

Annotation. The article discusses the possibilities of using artificial intelligence in the field of human face recognition in a digital video signal. The results of a literature review of computer vision technologies in the area under consideration are presented. The analysis of the relevance of the development of technologies for recognizing a human face in a digital video signal is also carried out. Since this direction is relevant, we considered the spectrum for the application of human face recognition technologies in various fields of activity. The article provides an overview of existing solutions provided by commercial companies from around the world and examples of their practical application.

Keywords: artificial intelligence, face recognition technology, computer vision, object recognition, commercial application.

SECTION 3: HISTORY, THEOLOGY, SOCIOLOGY

THE FATE OF THE GENOESE FORTRESS CEMBALO DURING THE OTTOMAN PERIOD (1475-1774)

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Cognition of the historical and cultural roots of Homeland, the formation of historical responsibility for society events, knowledge about the native land is of particular relevance today within the framework of historical and local history education, which orients a person to study the centuries-old history of the Fatherland, its role in the historical process, history and traditions of Crimea, morals, customs and traditions of nationalities [2]. The historical and regional studies direction is investigated in the works of M.A. Gorbova, G.V. Lisetskaya, Yu.M. Ikonnikova, A.V. Kuznetsova, G.A. Tonkova and others.

The main goal of local history education is the forming knowledge about the historical events of Crimea, the education of a moral person who loves and knows the land - the territory that is the object of the activity of local historians [5]. To achieve this goal, one should:

– study the history and modernity of Crimea;

– develop motivation for forming knowledge about the native land;

– promote personal quality development by means of local history in the process of creative collective activity.

It is possible to expand knowledge about specific aspects of the history or modernity of the region by means of project activities, which implies a theoretical analysis of historical facts unknown or less described in the literature. An example of such study is a creative project about the fate of the Genoese fortress Cembalo in the Ottoman period.

"The fortress of Cembalo is located atop Kastron mountain in the south-east coast of the Bay of Balaklava, 12 km far from the historical center of the city of Sevastopol. Nowadays, modern Balaklava is a district of the present Sevastopol offering a beautiful site of the Crimean seashore

with specific climate and landscapes, as well as interesting historical monuments" [8, www]. Ruins of medieval fortress of Cembalo preserved to these days. This fortress history is connected with the Genoese colonization of the Crimea in the 14th and 15th centuries [8].

The Genoese appeared in the harbor of Balaklava. The exact date of its origin is unknown. "This episode obviously took place shortly before a devastating raid of the Mongol and Tatar hordes against the Crimea in 1345" [8, www]. The Genoese conducted fortifications of their Black Sea colonies. It started building of a fortress at the mouth of Balalklava bay and became the westernmost Crimean district of the Genoese republic and home to the Cembalo consulate. The building of the fortress was completed in 1467 [8].

It is a well known fact that the former Genoese possessions on the territory of the Crimean Peninsula were seized in 1475 by the Ottoman Turks. The Chronicle of the Armenian church leader Grigor Daranagtsi (1576-1643) states the following about this: "In the summer of 924 (1475) Akhmat Pasha, whose nickname was Ketuk (the builder of fortresses), went out to the Black Sea in seven hundred galleys, On June 6, Kaffa took along with the country – Sugais (Sudak), Palykhluy (Balaklava). In the fall, Mancub was also given away and the Turks massacred the masters there [4, p.29].

So the Cembalo-fortress, erected by the Genoese in the XIV on the slopes and the top of the Fortress Mountain to the left of the entrance to the Balaklava Bay, in the summer of 1475 after a short siege, half-burnt was taken by an attack by the Ottoman troops under the command of Gedik-Ahmed Pasha.

The Crimean khans from the Girey dynasty recognized their vassal dependence on the Port and, as a result, the conquered lands were divided by the Turkish authorities into three Kadylyks: Mangup, Sugdei and Kefi. This is how the Ottoman-Tatar period (1475-1783) began, not only in the history of this fortress, but also in the history of Crimea.

Cembalo was renamed to Baliklaga (Balaklava), which means "fishing place". And gradually, it turned into only a small garrison having lost its former role, which performed the only function – the police, and even then only in peacetime. "The equipment of its arsenal, even in the 16th century, consisted of almost 50% of outdated war trophies captured by the Turks during the capture of the fortress back in 1475" [1, p. 38].

According to the census (mufassal defteri) of the Kefeot province in 1520, the number of inhabitants of Balaklava (21 people) was significantly inferior to Azak (307 soldiers), Kefe (234), Temryuk (149), Taman (124),

Lakhot (60), Mangup (37), Kerch (35), exceeding only Inkerman (19) and Sudak (11) [2, p. 325].

At the garrison headquarters, headed by the commandant (dizdâr), there were 15 soldiers (mustahfız), a gunner (topçu), a gunsmith (cebeci), a muezzin (müezzin) and an imam (imam).

In the same Turkish census, it is said that on the territory of the city of 5.8 hectares there was one quarter inhabited by Muslims. 4 bachelors, 25 families and 14 widows lived there. "The Jami-and Kebir mosque was built for them. In addition, there were separate quarters of Jews (15 families), Armenians (14 families) and Greeks (18 widows, 126 families). Gradually, the Jewish quarter disappeared, the number of Greek temples decreased, and the percentage of Muslims increased significantly by 1542. Tatar community emerged, and a small Friday mosque with an adjacent quarter was erected" [2, p. 325].

The reports of several travelers describing in their notes the fate of Chembalo in the 16th-17th centuries, which have survived to this day, contains very little information.

Polish historian and diplomat nobleman Martin Bronevsky, writing in his work "Description of Tartary" (1578) about Balaklava, noted only that the towers and walls erected by the Genoese arrived in a dilapidated state, and the city itself was practically not inhabited. He also states that seldom merchants visiting the fortress arrive here by sea. Perhaps this can indirectly indicate the then location of the fortress and the city away from the land routes.

Emiddio Dorottelli D'Ascoli, who was the head of the Seaport in 1624-1634, also considered the predominance of the sea route over the land route in these places. Dominican Mission in Kaffa. In his book "Descriptions of the Black Sea and Tartary" (1634), "the monk expressed the point of view according to which shipbuilders lived in Balaklava, building galleys and other ships from the local timber" [1, p.121].

The famous Turkish traveler Evliya elebi (1611-1682), who visited the Crimean peninsula in the 40s, and later in the 60s of XVII century, wrote in his "Book of Travels" the most curious and detailed information about the former Genoese outpost. In particular, he stated that the Ottomans used citadels as a lighthouse. During the sea navigation period, which lasted from spring to late autumn, a special lamp was lit at its top. Also, the author of the book draws attention to the presence of a spring in the fortress. There was no ditch in Balaklava. Inside the building are 50 small soldiers' houses with tiled roofs. "Apart from the buildings mentioned, there is no trace of a market or bazaar, a bathhouse or an inn inside the fortress" [5, p.110].

Speaking about the city located below the fortress, the traveler mentions two blocks with two hundred houses, mostly wooden. There was one small bathhouse (hamam) and one inn (han). There was a customs building on the sea coast. Due to the rocky terrain in these places, there was no opportunity to engage in viticulture and horticulture. Vineyards and gardens were missing here.

It is noteworthy that from 1666 until 1783, when Crimea officially became part of the Russian Empire, practically nothing has changed in the overall appearance of the city. In its chapels, only one inn (han) at the pier and one bathhouse (hamam) functioned. There will also be a central market square and the only road from the city at that time.

In 1784, on the initiative of the governor-general of the Taurida province, Prince Grigory Aleksandrovich Potemkin (1739 -1791), Arnautsk Greek infantry regiment was sent to Balaklava to ensure the protection of the coastline from Sevastopol to Feodosia. And the remaining Turkish population gradually moved to the Ottoman Empire. Thus, a new stage in the history of Chembalo-Balaklava began.

Based on mentioned above, we can conclude that the framework of historical and local history education is an important task of modern education, and local history work is one of the areas of patriotic education, which provides effective results in the formation of feelings of patriotism, pride in the Homeland, environmental culture and the development of cognitive creative activity.

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Аннотация. Актуальность данной статьи заключается в потребности нашего государства в патриотической личности, владеющей знаниями о родном крае, об истории Отечества, его роли в историческом процессе, истории и традиций. Представлены исторические факты Балаклавы, описана судьба генуэзской крепости Чембало в османский период (1475-1774 гг.), которая сыграла значимую роль не только в истории данной крепости, но и в истории Крыма.

Ключевые слова: Историко-краеведческое воспитание, краеведение, Крым, Чембало, Балаклава, Османская империя.

Annotation. The relevance of this article is in our state's need for a patriotic personality who possesses knowledge about the native land, the history of the Fatherland, its role in the historical process, history and traditions. The historical facts of Balaklava are presented, the fate of the Genoese fortress Cembalo in the Ottoman period (1475-1774), which played a significant role not only in the history of this fortress, but also in the history of Crimea, is described.

Key words: Historical and local history education, local history, Crimea, Cembalo, Balaklava, Ottoman Empire.

UDC 623
UNKNOWN PISTOL OF THE GREAT PATRIOTIC WAR
(LENINGRAD "BALTIETS")

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Introduction

We are celebrating one the most important dates in the history of our homeland, the 76th anniversary of the Victory in the Great Patriotic War.

The Great Patriotic War began in 1941 and lasted for 4 years. Soviet engineers had to develop weapons to defend our homeland. But there were also weapons that were produced in limited quantities by skilled workers. I want to talk about one of this weapon – the "Baltiets".

The purpose of this work is to describe the pistol "Baltiets".

From the history

The history of the pistol began in 1941. Baltiets – soviet pistol, developed in Leningrad, in the first winter of the blockade. The reason for the development was complaints about poor performance at low temperatures. On behalf of the bureau of the Leningrad regional committee, it was decided to entrust the Leningrad plan №181 and its director Rumyantsev to design and manufacture a trial batch of 15 pieces [1].

Technical specifications
Mass: **0,96 kg**
Barrel length: **120 mm**
Ammo: **7.62 × 25 mm TT**
Caliber: **7.62 mm**
Effective firing range: **50 m**
Feed system: **8-round detachable box magazine**
Action: **blowback**

The German Walter PP was chosen as the basis for the design.

In January 1942, the chief designer and the technologist of the plan №181 created sketches of parts for manufacture of a pistol. The senior foremen of the sections were entrusted with making the first batch of pistols. All parts were made by hand, without previously prepared equipment and handicraft processed by bluing.

A copy of the pistol No. 1 was assembled at the factory in March 1942. The tests were carried out at a temperature of -30°C in an empty workshop. Automation worked without delay, the accuracy was high enough. But the copy turned out to be very heavy, but this shortcoming was corrected in copy No. 2. However, during the assembly it turned out that there were not enough parts, and 14 pistols were assembled out of 15 sets of parts [2].

Several people were convicted of designing and assembling a new pistol model without permission from Moscow.

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Аннотация. Цель исследования – описать пистолет «Балтиец». Перечислены основные технические характеристики.

Ключевые слова: Великая Отечественная война, пистолет «Балтиец», немец Вальтер П.П., копия.

Annotation. The purpose of the study is to describe the pistol "Baltiets". The main technical specifications were listed.

Keywords: the Great Patriotic War, the pistol "Baltiets", The German Walter PP, copy.

FORMATION OF THE PERSONALITY OF K.K. ROKOSSOVSKY AND HIS ACTIVITITY DURING THE FIRST WORLD WAR

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The modern period in Russian history and education is a time of changing values. Personal values are formed in the family, communities, and other collectives, in the field of mass media, art, recreation, etc. But the most systematic, consistent and deeply spiritual and moral development and upbringing of the individual takes place in the sphere of education [4]. Formation of a person's ability to evaluate and consciously create an attitude towards oneself, other people, society, the state, the Fatherland, on the basis of traditional moral norms and ideals.

Spiritual and moral education of the personality of a citizen of Russia is the process of assimilation and acceptance by students of basic national values that have a hierarchical structure and a complex organization [3]. In the sphere of personal development, students' upbringing should ensure the strengthening of faith in Russia, a sense of personal responsibility for the Fatherland before the past, present and future generations [6]. The content of person's spiritual and moral development and upbringing acquires a certain character and direction depending on what values society shares, how their transmission from generation to generation is organized. To solve the problem of spiritual and moral education of the individual, one should turn to the content of the history of Russia, peoples, one's family, clan. For this purpose, a scientific and practical conference is held annually on the basis of the Sevastopol State University, which is dedicated to the Victory Day in the Second World War [12-13], where various issues are considered, including the personality of outstanding people during the war years. The choice of this topic is due to the relevance of the problems of historical psychology, in particular, its special period of the First World War.

The purpose of this article is to consider the formation of the personality of K.K. Rokossovsky and his activities during the First World War. It is impossible to understand why he was known as the "soul of the army" and how he differed in the spiritual and psychological sense from other generals of the era, bypassing the reconstruction of the stages of the formation of his identity. Research method is a literature study. The objective of the research is to analyze the stages of the formation of personality identity by K.K. Rokossovsky in order to understand and take into account the lessons of this tragic and great period of our history.

Life path of K.K. Rokossovsky was studied by V.V. Nosyrev, A.S. Basov, P.A. Teremov, S.I. Rudenko, L.M. Mlechin, A.F. Korolchenko. Probably, there is no other such person in the history of the twentieth century who would be so differently assessed in Russia and in Poland, as "Marshal of the two nations" – Konstantin Konstantinovich Rokossovsky. The interpretation of this most important person in military history also reveals the difference in the outlook and perception of the Second World War, the post-war arrangement of Eastern Europe.

Spiritual and moral development of the personality is person's ability formation to evaluate and consciously build on the basis of traditional moral norms and moral ideals, attitude towards oneself, other people, society, the state, the Fatherland, the world as a whole. Spiritual and moral education of the personality of a citizen of Russia - a pedagogically organized process of assimilation and acceptance by students of basic national values that have a hierarchical structure and a complex organization. The Great Patriotic War of 1941-1945 gave a whole galaxy of great military commanders and commanders. And among them is Marshal of the Soviet Union Konstantin Konstantinovich Rokossovsky – one of the outstanding and talented commanders. The troops led by him fought on the most important sectors of the Soviet-German front. His glorious combat path includes Border battles, the Battle of Moscow, the Battle of Stalingrad, the Battle of Kursk, the Battle of the Dnieper, Belarusian, East Prussian, East Pomeranian, Berlin strategic operations. Troops under the command of K.K. Rokossovsky never experienced the bitterness of defeat. His military career was based on selfless service to the people, self-discipline, dedication, high exactingness to his subordinates to himself, to his professional training.

Historical experience shows that the formation of the personality and talent of a military leader is a long and multifaceted process. Like many other outstanding commanders, K.K. Rokossovsky went through a number of stages in his personal and professional development. His moral qualities were formed during childhood and adolescence, and subsequently improved in the course of acquiring professional military knowledge and skills. K.K. Rokossovsky began to acquire the qualities of a military leader with the beginning of military activity during the First World War.

K.K. Rokossovsky was born on December 21, 1896 in the city of Velikiye Luki. He came from a fairly wealthy Polish family. His grandfather, Jozef Rokossovsky, was an officer in the 2nd Cavalry Regiment during the Principality of Warsaw. Constantine's father, Xavier, worked as a railway engineer, which was very honorable at that time. His mother, Antonina Ovsyannikova, is Russian, teacher from Pinsk. A calm, benevolent and respectful family atmosphere at the very first stage of

personality formation developed such qualities as modesty, a sense of justice, and decency. Since childhood, Konstantin was fond of reading military history literature. Education at the city school contributed to the formation of a world outlook and broadening of horizons in military affairs. However, KK Rokossovsky had no military education by the beginning of the First World War [2].

The hardening of volitional qualities based on a sensitive attitude towards another people began with the death of his father in August 1905, and then his mother in 1910. At the age of 14, Konstantin Konstantinovich went to work. The work varied: an assistant in a pastry shop, a dentist's assistant, a worker in a knitwear factory, a mason. The First World War radically changed the fate of Konstantin Konstantinovich Rokossovsky. On August 16, 1914, the 5th Cavalry Division arrived in the town of Gruez, where he lived. Among the recruits who replenished the division until the wartime states, there was Rokossovsky, who voluntarily went to serve in the army, adding three years verbally to himself, because the army at that time was drafted from twenty-one [5].

K. Rokossovsky was assigned to the 6th squadron of the 5th Kargopol dragoon regiment. The training of young soldiers was short-lived. For six days, non-commissioned officers learned how to use weapons, horse riding, but above all, watch the horses. This was one of the main rules of the cavalry. It was the careful care of the horses during the period of Rokossovsky's service in the cavalry that more than once rescued the future commander. The rest of the basics of military service and combat activities Konstantin Konstantinovich mastered already in the course of hostilities.

K. Rokossovsky took part in battles near the Pilica river near the town of Nove Miasto. Here the advance units found enemy cavalry. It was necessary to make reconnaissance. Konstantin volunteered to carry out such a difficult and responsible task. He changed into civilian clothes and went to the German-occupied town.

Due to attentiveness, knowledge of the organizational structure, the nature of the enemy's actions, in three hours the young dragoon accurately determined the composition and location of the enemy's cavalry regiment and the artillery attached to it, as well as other auxiliary units. For an excellently completed combat mission, Rokossovsky was encouraged by the command. In October 1914, acting on patrol, Rokossovsky discovered an enemy ambush, but was immediately surrounded. K. Rokossovsky boldly rushed to the enemy, hacked to death the German cavalryman and made his way to his unit. For his courage he was awarded the St. George Cross of the fourth degree under number 9841 [11].

At the beginning of the First World War, there were typical cases of ineffective command and control of troops by the command of the 5th Cavalry Division, which the future commander had the opportunity to observe. For example, the 72nd Tula Infantry Regiment for two days unsuccessfully attacked the Austrians, suffering heavy losses. The command of the division continued to throw infantry into battle without proper artillery support and did not use cavalry to break through the enemy's defenses. Daring and decisive actions of the cavalry brought success to the formation [14]. For the young Rokossovsky, this was one of the clear examples of how to defeat the enemy, but he was always a supporter of high military discipline and diligence. Nevertheless, he learned one of the most important rules of command and control. The combat situation is constantly changing and the skill of the commander is to react in a timely manner to its changes. It is impossible to defeat the enemy with routine actions. One should know and understand the essence of the armed struggle, the nature of the enemy's actions, freely orient oneself on the battlefield and make timely decisions appropriate to the situation.

Dragoon Rokossovsky showed high fighting qualities in a battle near the town of Ponevezh in the spring of 1915. The signal of a combat alert caught the squadrons of the division during their unloading at the railway station. The enemy was advancing on the city. The division attacked the enemy [5]. From this battle, Rokossovsky made an important conclusion that the troops should always be in constant readiness for battle, so during the formation, regrouping, on vacation, etc. This can prevent the enemy from taking them by surprise. In addition, initiative in battle contributes to success in battle.

Courage was one of the main Rokossovsky's quality during the war years. So, on July 19-20, 1915, in the battles for the Trashkuny railway station, Rokossovsky with non-commissioned officer E. Meshkov and others in a night sortie captured the enemy's field guard and during the day repelled the attacks of the Germans [8]. All five daredevils were awarded the St. George medals on July 20, 1915 [9]. Recognition of the military merits and high qualities of the fearless cavalryman was the fact that in the winter of 1915, already senior dragoon Konstantin Rokossovsky was transferred to a reconnaissance platoon, where he distinguished himself on May 6, 1916 [10].

Konstantin Rokossovsky received his first military education (not counting the six-day training of young soldiers) in October 1916 in a special training team at the 1st Reserve Cavalry Regiment, where he was sent for training in non-commissioned officers as the most distinguished in battle. During his studies, he acquired a large stock of knowledge and skills that

non-commissioned officers must possess and which cannot be obtained at the front.

After returning to the regiment, junior non-commissioned officer Rokossovsky continued to participate in defensive battles. Despite the ferment among the soldier masses, desertion Rokossovsky conscientiously fulfilled his duties. During the defensive battles and the retreat from Riga, the 5th Cavalry Division fought restraining battles on foot. Together with other dragoons, junior non-commissioned officer Rokossovsky repeatedly fired at the German forward detachments, hindering the enemy's actions and slowing down his pace of advance [1].

In October 1917, in the 5th Kargopol Dragoon Regiment, officers were removed from command, which passed to the regimental committee. Kaptenarmus Ivakin was elected chairman of the regimental committee, and senior non-commissioned officer Stafeev was the commander of the 4th squadron. The remaining officers were assigned to platoons. K. Rokossovsky, distinguished by a sufficiently large physical strength, courage, the ability to beat the enemy, but being humble by nature and loyal to the oath, was not elected to any of the high leadership positions [2].

During the First World War the character of Rokossovsky was formed and tempered in the harsh combat. Restrained, calm, confident, devoid of bragging, he retained goodwill for the rest of his life, the desire to understand a person, to enter his position, which was subsequently perceived by his bosses as gentleness. K. Rokossovsky, possessing a will and a strong character, was devoid of cruelty and rudeness towards all those around him.

The First World War for Konstantin Rokossovsky finished in December 1917 at Dikaya station, 26 km west of Vologda. The regiment in which he served was disbanded. Having joined the ranks of the regular army in August 1914, K. Rokossovsky passed the combat path together with his regiment from the town of Grojec (south of Warsaw) to the station. Dikaya (region of Vologda). For 40 months of the war, he participated in hostilities, marches, restoration of combat capability, studied, etc. Quite a lot of experience was gained in defensive actions. During the war, Konstantin rose to the rank of junior non-commissioned officer, gained rich combat experience. During this period, he developed views on the conduct of hostilities against an enemy who had a fairly high level of organization on the battlefield, who had modern means of warfare and was able to use them. In the areas where K. Rokossovsky fought, artillery and machine guns were one of the main enemies of the cavalry.

Thus, Konstantin Rokossovsky was formed as a person by the end of the First World War, who was well versed in military affairs at the level of a

private – non-commissioned officer. However, he had no experience in commanding subunits. Possessing such qualities as courage, courage, decisiveness in battle, the ability to quickly understand a difficult combat situation and make the right decision, initiative, loyalty to duty, etc., he was able to captivate his subordinates. He liked military service. The received combat experience, inborn and acquired during the war, professional and moral qualities became the foundation for the formation and development of K. Rokossovsky as a commander, military leader.

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Аннотация. В сфере личностного развития воспитание должно обеспечить чувства личной ответственности за Отечество перед прошлыми, настоящими и будущими поколениями. Для решения задачи духовно-нравственного воспитания мы обращаемся к содержанию истории России, народов, своей семьи, рода. Целью данного исследования является анализ формирования личности К.К. Рокоссовского и его деятельности в годы первой мировой войны.

Ключевые слова: духовно-нравственное воспитание личности, духовно-нравственное развитие личности, история, личность К.К. Рокоссовского.

Annotation. Education should provide a sense of personal responsibility for the Fatherland to past, present and future generations in the field of personal development. To solve the problem of spiritual and moral education, we turn to the content of the history of Russia, peoples, our family, clan. The purpose of this study is to analyze the formation of the personality of K.K. Rokossovsky and his activities during the First World War.

Keywords: spiritual and moral education of a person, spiritual and moral development of a person, history, personality of K.K. Rokossovsky.

"THE ANNUNCIATION TO THE VIRGIN MARY" STORY IN CHRISTIAN ICON PAINTING

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The icon, annotated by experts as belonging to the manner of the great icon painter Andrei Rublev (the icon was part of the iconostasis of the Kremlin's Annunciation Cathedral, is now in the State Tretyakov Gallery), was made presumably in 1405. Attribution is based (with poor preservation of the icon) on the peculiarities of its color, the use of characteristic pigments, as well as on the general mood created by the peculiarities of the compositional solution.

The main feature of the interpretation of the plot is in the creation of a special dichotomy, the personalization of plot lines which are opposite in nature - the image of the archangel Gabriel, informing the Virgin Mary of her high mission, is presented in the powerful dynamics of the figure of the messenger of the lord, and the reaction of the Virgin Marygod embodies the effect of her reaction to a miraculous sudden appearance - then a state of elusive impulse, in which feelings of confusion, surprise and acceptance of the Will of God are combined.

A difficult state is conveyed by the symbolic gestures of the hands of the Mother of God – a hand pressed to the chest reveals the depth of emotional excitement, and an outstretched hand to the Messenger signifies the full acceptance of the Lord's Will. The icon is distinguished by compositional clarity, free perception from a distance, which is ensured by highlighting the central axis, towards which figures are directed from its opposite sides, making visible the state of moments of dialogue, the interaction of two spaces. The figures striving towards each other personify the heavenly and the earthly. The idea of the Incarnation is shown by the Holy Spirit, which descends on the Blessed Virgin Mary in the form of a green ray.

Usually for the Old Russian tradition, contrary to the Byzantine models, which present this plot in gloomy tones, here is embodied a festive color especially characteristic of Andrei Rublev, based on the sacred flowers of bright cinnabar, juicy green, blue and cherry tones, set on a gold background.

In this description, the features of the unique style of the great icon painter, the basis of the Russian icon painting tradition is reflected.

In Catholic Christianity, one should make a comparative analysis of the work of Simone Martini, the largest artist in Italy in the first half of the 14th century. One must consider the famous Annunciation (now Florence, Uffizi) for the altar of St. Ansonia in the Siena cathedral.The plot also unfolds against a shining gold background, emphasizing the unearthly atmosphere of the annunciation. A dove is depicted under the central vault in the crown of cherubs - a symbol of the Holy Spirit. Drawn against a gold

background, the text, as if coming out of the mouth of an angel, represents the first words of the "good news."

The Virgin Mary is realistically depicted sitting on an inlaid wooden throne, with a book in her left hand. The figure of Mary, listening to the good news, is written in an airy, soulful manner, although her dark blue cloak and red dress contrast with the dazzling brilliance of the entire scene. The figure of an angel, dressed in a brocade robe, is emphasized by the wings with peacock feathers looming against a gold background and the whimsical folds of a decorative writhing cloak. The figures of saints are depicted on both sides of the altar: on the left side is St. Ananias, (this altar was dedicated to him), on the right one according to an inscription made in the 19th century, St. Julitta is presented.

The plot and color, the smoothness of the lines of Mary's pose seem to bring these two works together. A personal, lively experience of the event, deep poetry is characteristic of the fresco "Annunciation" by Simone Martini's and the Rublev's work.

Conclusion. Summing up, we can note that in both Italian and Russian icon painting there were original artists who were not afraid to become innovators, to interpret the plots of sacred history in their own way. Despite the difference in the methods and techniques of the image (naturalistic in Martini, conditionally symbolic, symbolic in Rublev), the painters created works that make any viewer think about the eternal, regardless of nationality and religion.

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Аннотация. Доклад посвящен результатам проведенного исследования в области сопоставительной иконографии, обозначивших различные подходы к воплощению образов популярного сюжета как в древнерусской иконографии, так и в католической картине.

Ключевые слова: Пресвятая Богородица, сопоставительная иконография, собор Кремля, дихотомия, архангел Гавриил.

Annotation. The report is devoted to the results of the research carried out in the field of comparative iconography, which indicated various approaches to the embodiment of images of a popular plot both in ancient Russian iconography and in a Catholic picture.

Keywords: Mother of Jesus comparative iconography, the Kremlin Cathedral, dichotomy, the Archangel Gabriel.

THE PROBLEM OF THE INTERDEPENDENCE OF CAPITAL AND WARS

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Introduction

The problem of global instability characterized by constant wars unleashed by the West against many countries: Afghanistan, Iraq, Libya, Syria – requires careful philosophical and sociocultural research. The real cause of wars is not associated with religion, nationalism, or terrorism. In our opinion, the only reason is economic. Capitalism cannot exist without wars because the goal of the capitalist economy is not to produce goods and provide services, but to make a profit. The greatest profit to the capitalists is given by those 'goods and services' that are necessary for the conduct of wars.

The purpose of this paper is to examine the problem of the interdependence of capital and wars.

Materials and Methods

The scientific correctness of the analysis of capitalism presented in the studies of A. Smith, and later in the works of K. Marx, F. Engels and other scientists is becoming more and more obvious.

In "*The Study of the Nature and Causes of the Wealth of Nations*", Adam Smith was the first who formulated the concept of productive labor as the source of nations' wealth. In the part "*On the nature of capital, its accumulation and application*", Smith showed that the market is an ideal regulatory mechanism for the economy [5]. Capital, according to Smith, is the stock of goods that bring or can bring income. The owner of capital buys their labor from the workers and hope to make a profit under the size of the invested funds, and this encourages him to invest as much as possible.

Karl Marx builds the logic of the capital development starting with its simplest form – the commodity– in his most famous work "*Capital. Critique of political economy*". This logic of development is derived from the material history of capital itself. The reason for the crises Marx and Engels saw in the pursuit of profit, in the free increase in the industrial goods production without taking into account the total need for them [4, 3, 2].

Results and Discussion

The world economy is arranged in the form of capitalism which implies money into goods producer, which increase the amount of money forming a cycle: on the one hand, money breeds a war; on the other hand, as Louis the Twelfth said, to fight the war, you need three things: money, money, and money again.We must admit, this cycle has its own origin.

The whole thing started with initial accumulation. Capitalist attitude implies that ownership on producer goods is detached from workers. Capitalist production maintains separation and reproduces it.

So the process of capitalist attitude creation is the process of separation workers from their ownership.

The era of capitalism has begun in the sixteenth century when feudal exploitation was replaced by capitalist exploitation. It was achieved by concentration of producer goods in hands of minority and liberance of workers by withdrawal of all producer goods and deliverance from feudal dependence.

Let's examine these processes on the example of capitalization of England. Until the 16th century, the predominant majority of the population were free peasants. The land and means of production were leased from the feudal lords. This arrangement of the economy created conditions for national prosperity, but prevented the accumulation of capital.

Favorable conditions for business emergence were created by chance. Because of the desire for absolutism, the royal power dissolved the feudal squads. In parallel with these events, a sharp rise in the wool manufactory took place which required the mass breeding of sheep. There was a need to turn arable land into pastures. These circumstances led to peasants' expropriation.

For these economic purposes, an entire nation was oppressed for several centuries, leading to the Irish War of Independence. It broke out in 1641 during the reign of Charles the First, but his loyalty to the Irish did not suit the capitalists. As a result, Charles the First was deposed by the tyrant Cromwell.

The new henchman of the parliament immediately went to suppress the rebels. As a result, Cromwell began to drive the Irish off the land and sell it to adventurers.

Soon the monarchy was restored, and the crown went to James the Second, but because of his reforms in favor of the Irish, he did not have popularity in England, and soon the ruler of the Netherlands, William the Third Oransky, was invited to the throne. Fighting broke out again on the territory of Ireland. William the Third – at the head of the Protestants against James the Second with his Irish army. The British were victorious again.

It is interesting but all of these wars were fought under the pretext of the transformation of Catholic Irish to Protestants. However, William's campaign was blessed by the Pope. Most likely, religion in these matters did not care. The only significant result of the above-mentioned clashes was the expropriation of the Irish.

So, in 1641, the native population owned 59% of the territories, under Cromwell – 22%, in the time of William – 14%, and by 1714 – only 7%. Thus the capitalists received vast private lands and cheap labor: the Irish people thrown on the sidelines of life.

Let's bring to the concept of capital turnover from the beginning of our research: the more money, the larger the production. And a lot of money was needed for the new class of industrialists to win over the shop system.

Once again, the opportunity was favorable: the discovery of new lands contributed to the enrichment. And the lack of any humanity and capitalists' selfishness allowed them to enslave the natives, plunder the East India, and appropriate the gold and silver mines in America. After acquiring huge amounts of capital, a new class of cheats (crooks) needed large markets. The trade policy was very clearly expressed in the form of the opium war with China.

Since 1757, Europeans were forbidden to trade with China, as the emperor of the Middle Kingdom considered the Western civilization as barbaric. The only exceptions were the ports of Macau and Canton, but trade was carried out only in a limited number of goods and through an intermediary which is extremely unprofitable for capital.

India, the world's leading opium producer, came to the rescue. The East India Merchant Guild was granted a monopoly on the sale of opium. Then the smuggling of opium into Chinawas organized.

The population's fascination with the drug drove Chinese production down, while the death rate increased. In addition, the opium trade devalued copper coins as transactions were made for silver, which grew in value. And copper was devalued, but it was the main means of exchange, and as a result, the poor population became even poorer.

This did not suit the emperor, and in 1839 a commissioner was sent to Canton, who arrested representatives of the East India Company and forced them to surrender opium. After this incident, China completely stopped trading, and England had a reason to declare war.

An expedition was sent from India: 40 ships. Due to the technical advantages, the British won a number of serious victories and forced the emperor to negotiate. As a result of the agreement:

- 5 ports were opened and trade through agents was canceled;
- Hong Kong was transferred to England;
- 21 million contributions were paid;
- trade duties were reduced from 15% to 5%.

The result of these changes was the following:

- opium supply increasing;
- ruining of native population by English weavers;
- taxes increasing due to the cheaper copper coin.

Revolutionary sentiments have intensified among the people. The Taiping Organization raised an insurrection that lasted as a civil war for 8 years.

In 1850, the new Sianfeng Emperor refused to renegotiate the trade treaties, and in 1856, the second opium war began. The coalition of England and France won, then Russia and the United States joined the treaty.

The result was new conditions:

- 6 new ports;
- opening of foreign embassies;
- permission to trade on the Yangtze river;
- the right of the English and the French to free movement in China;
- legalization of opium sales and production in China;
- 16 million contributions;

- permission to export Chinese workers abroad;
- transferring parts of the Jiulong Peninsula and Burma to England, the northern lands of China to Russia, and Indochina to France.

This destructive war led to massive opium addiction, economic abyss, and political dependence.

Thus capital shows its true face, asThomas Joseph Dunning accurately statedin 1860:

Capital avoids no profit, or very small profit, just as Nature was formerly said to abhor a vacuum. With adequate profit, capital is very bold. A certain 10% will ensure its employment anywhere; 20% certain will produce eagerness; 50%, positive audacity; 100% will make it ready to trample on all human laws; 300%, and there is not a crime at which it will scruple, nor a risk it will not run, even to the chance of its owner being hanged. If turbulence and strife will bring a profit, it will freely encourage both. Smuggling and the slave-trade have amply proved all that is here stated [1].

Thus, all wars will continue as long as capitalism exists. After all, the military-industrial complex of the West imperiously demands an uninterrupted flow of state orders. For the capitalists, war is always just a very profitable business.

Conclusion

Based on the analysis of the problem of the interdependence of capital and wars, the following conclusion can be drawn.The mutual influence and interdependence of wars – both former and present – and capital are obvious and beyond any doubt. The main reason of wars is economy. The main source that feeds the economy is war.

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Аннотация. В статье представлено исследование проблемы взаимообусловленности капитала и войн. Социокультурные условия и

процессы, способствующие возникновению капитала рассмотренына примере капитализации Англии. На основе анализа трудов А. Смита «Исследование о природе и причинах богатства народов», К. Маркса «Капитал. Критика политической экономии», а также Ф.Энгельса «Происхождение семьи, частной собственности и государства: В связи с исследованиями Льюиса Г. Моргана» выявлено, что взаимообусловленность капитала и войн – как прежних, так и нынешних – очевидна и не подлежит никакому сомнению. Главная причина всех войн – экономическая: извлечение прибыли. Главный источник процветания капиталистической экономики – война.

Ключевые слова: возникновение капитала, войны, капитализация Англии, капиталистическая экономика.

Annotation. The problem of the interdependence of capital and wars is examined in this article.The sociocultural conditions and processes that contribute to the emergence of capital are considered on the example of the capitalization of England.Based on the analysis of A. Smith's "*The Study of the Nature and Causes of the Wealth of Nations"*, K. Marx's work "*Capital.Critique of political economy*", as well F. Engels' "*The origin of the family, private property, and the State: In connection with the research of Lewis G. Morgan*", the following conclusion is drawn: the mutual influence and interdependence of wars – both former and present – and capital are obvious and beyond any doubt. The main reason of wars is economic one: making a profit. The main source of the capitalist economy prosperity is war.

Keywords: the emergence of capital, wars, the capitalization of England, capitalist economy.

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THE PROBLEM OF INVENTIONS ORIGIN IN THE CONTEXT OF CAPITAL AND WARS MUTUAL INFLUENCE

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Introduction. A large number of people use the services of airlines every day. It does not matter – whether it is business or leisure. A plane will take you anywhere in the world quickly and comfortably because it has turbojet engines! However, where did such engines come from? After all, how do various inventions appear in our lives? The analysis of such sources

as Karl Marx's *Capital. Critique of political economy*, Adam Smith's *The Wealth of Nations*, K. Marx and F. Engels' *Letters on "Capital"*, F. Engels' *The origin of the family, private property, and the State: In connection with the research of Lewis G. Morgan*, etc. gives us reason to say that a great many of things which are considered inventions were originally intended for military needs.

The aim of this article is to examine the origin of the inventions that changed the life of mankind, inventions that provided a breakthrough in the development of the world's industry. The appearance of these inventions became possible, as it may not seem strange, in times of the most terrible tests – in times of military operations.

Materials and Methods. In his most famous work *Capital. Critique of political economy* K. Marx deals with the fact that on the basis of numerous material evidence, he builds a logic of the development of capital, starting with its simplest form – the [3]. Thus, this logic of development is deduced by him from the material history of capital itself [1, 2].

But Adam Smith's *The Wealth of Nations* was the first systematic presentation of the foundations of economic science. In this book, Smith criticized mercantilism and formulated the concept of productive labor as the source of the wealth of nations. According to A. Smith, economic development is the forces operating in human society and the laws that increase total income. The author is interested in the relationship of people in the process of productive labor, income distribution, capital accumulation – all that became the subject of political economy thanks to Smith [4]. At the same time, the philosopher considers agriculture, not industry, to be the main source of the wealth of society because the industrial revolution in the Smith era was just beginning, and it could not become obvious until the 1780s, after the publication of *Wealth*.

Smith interpreted capital as the stock of goods that bring or can bring income. The owner of capital buys their labor from the workers, hoping to make a profit in accordance with the amount of money invested, and this encourages him to invest as much money as possible.

Results and Discussion. By the early 19th century, Smith's economic ideas were most influential in England and France, the two countries where the landowning elite was losing ground the fastest compared to the rest of Europe. However, initially their supporters were mostly 'practical people' – politicians and entrepreneurs.

In our opinion, capitalist economy development and the demands of military-industrial complex and are interrelated processes that move the economy forward.

Returning to the question of turbojet engines origin, it should be noted that the first aircraft to take to the sky with a turbojet engine (HeS-3) was the He 178 designed by von Ohain. It happened on August 27, 1939, a few days before the Second World War started. Von Ohain was not an innovator.

The first projects of jet engines appeared in the middle of the 19th century, but his plane was the first fully realized design. Work in this area continued further, but when the Luftwaffe began to lose the advantage in the air, the Reich command set the task of creating an aircraft that would surpass the Allied aircraft. So the jet fighter – bombard appeared.

The Me 262 with two Junkers Jumo-004 turbofan engines began to be mass-produced in August 1944. In November of the same year, the German fleet was replenished with the AradoAr 234 Blit 2 jet bomber with the same engines. All the technical documentation went to the Americans. The Soviet military was able to shoot down several of these aircraft, and the wreckage was delivered to their design bureaus. As a result, Boeing aircraft in the United States acquired jet engines, and in the USSR began to produce a civil jet TU-104, based on the TU-16 jet bomber.

Another technological marvel that is open initially for military purposes has become a nuclear power. However, at what cost?

On August 6, 1945, a B-29 "Enola Gay" bomber of the US Air Force dropped an atomic bomb on Hiroshima, killing 80 thousand people. On August 9, the Americans similarly demolished Nagasaki, taking the lives of 40 thousand people. And this is not counting oncological diseases that have affected several generations.

Convinced that nuclear energy has a huge potential, Igor Kurchatov decided to direct it in the right direction. After leading a group of outstanding Soviet scientists, he began to develop a nuclear reactor. In 1950, after several years of calculations and preparation, the construction of the world's first nuclear power plant began. So, in 1954, the Obninsk nuclear power plant appeared, which marked the beginning of a new era in the energy sector. It was based on the first uranium -graphite reactor AM-1.

At the moment, there are 192 nuclear power plants in 31 countries in the world. The leader in this area is the United States which has 62 nuclear power plants, followed by France which has 19 nuclear power plants. However, it is in France that the most powerful reactors at the Sivo station are located. Russia has 10 stations.

Thanks to many scientists' efforts, humanity was able to use atomic energy. But the examples of Selafield, Harrisburg, Chernobyl, and Fokusima show that the atom may be peaceful, but it is not peaceful by nature!

War is not just a confrontation between political factions, states, or alliances. War is also medicine's struggle with death: for every new weapon, medicine must respond with a new medication/drug, tool, or scientific knowledge.

Nikolai Pirogov made an invaluable contribution to the art of healing in general and to military field surgery in particular. Some of his discoveries had to be made in hospitals of the besieged Sevastopol during the Crimean War of 1853-1856.

He owns the idea of sorting the wounded by gravity. Five categories were identified: hopeless, requiring immediate assistance, able to survive delivery to the hospital, to be sent to the hospital and lightly wounded. This made it possible to preserve medicines in conditions of shortage and regulate doctors' work.

In addition, for the first time, a plaster cast was applied in Sevastopol by Pirogov, and starched dressings were actively used.

During the First World War people were seriously injured. This gave an impetus to the development of prosthetics. Before that, the prostheses were uncomfortable, there was no use from them, but only the appearance of person's integrity. Now that the demand for artificial limbs has increased, so has their practicality. An example of this is the design of a prosthesis with a nozzle on the arm, equipped with a forked hook that allows a person to perform simple everyday tasks.

21 years later, during the Second World War, medicine had to adapt to the new realities. Thanks to British scientists – Howard Florey, Ernst Cheyne and Norman Heatley – penicillin began to be produced on an industrial scale. They conducted their research in 1940-1941, based on the discovery of penicillin by Alexander Fleming in 1924. These discoveries made it possible to provide the Allied armies with the antibiotics needed in hospitals in many war theater areas.

Thus we saw that the war has become the impetus for some very significant discoveries and inventions. As someone once said, the road to war is paved with good inventions.

Conclusion. Based on the analysis of the problem of various inventions origin in the context of capital and wars mutual influence, the following conclusion can be drawn. The capitalist military-industrial complex, thanks to which there is a need for new developments in the field of technology, medicine, etc., is the main source of economic prosperity.

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Аннотация. Проблема появления различных изобретений в контексте взаимовлияния капитала и войн рассмотрена в статье. Классические труды таких учёных, как К. Маркс, Ф. Энгельс, А. Смит служат методологической базой для исследования обозначенной проблемы. Капиталистический военно-промышленный комплекс, благодаря которому появляется необходимость новых разработок в области техники, медицины и т.п., является основным источником процветания капиталистической экономики.

Ключевые слова: изобретения, взаимовлияние капитала и войн, капиталистическая экономика.

Annotation. The problem of various inventionsorigin in the context of capital and wars mutual influence is considered in the article. The classical works of such scientists as K. Marx, F. Engels, A. Smith serve as a methodological basis forthis problem study.The capitalist military-industrial complex, thanks to which there is a need for new developments in the field of technology, medicine, etc., is the main source of capitalist economic prosperity.

Keywords: inventions, mutual influence of capital and wars, capitalist economy.

HEROES OF 1031 RIFLE REGIMENT

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Introduction. It cannot be denied that the upbringing of patriotism is especially important today in the context of current events in the world. The deeds of the Heroes live in the memory of generations, becoming a symbol of courage and love for the Motherland [1].

It is very important to remember the exploits of Soviet soldiers; this is our history, which is an integral part of patriotic education. Having devoted

several years to researching and evaluating the documents about our grandfathers' feats, we had just found the information about the 1031st rifle regiment of the 280th rifle division, containing official statistical collections, historical information, the state and private archives which became data sources of the present article. These sources are devoted to the anniversary of Victory in the Great Patriotic War of 1941-1945.

Analysis of literature. Hundreds of thousands of statistical collection, the documentary, biographic books have been written about the Great Patriotic War. The statistical data presented in some publications reflect the country's social situation before, during the war and in the first years of recovery period [6]. "Management of Rosstat expresses deep gratitude to the Information and Publishing Center «Statistics of Russia», Military Scientific Library of the Russian Armed Forces' Preface 8 Central Museum, Scientific Research Institute for the War History of the Military Academy of the General Staff of the Russian Armed Forces, to E.M. Andreev and T.L. Kharkova of the Scientific Research University 'Higher School of Economics', as well as to Rosstat employees of its central office and territorial bodies, who took active part in drafting the anniversary publication" [6, p. 3].

The archives of the Great Patriotic War were declassified in June 2007. As a result, researchers gained access to previously unavailable documents. In early May of the same year, the public got access to updated data on the losses of the USSR in the war – a dispute about this issue has been going on since 1945. In 1946, Joseph Stalin announced about 7 million deaths among the military and civilian population, then this figure was constantly "growing".

In 2007, the former head of the Military Memorial Center, Alexander Kirilin, said that, according to updated data, the number of soldiers killed in the Great Patriotic War was 8,860,400.

The Committee for the Management of Archival Affairs has published a unique set of archival documents dedicated to the history of the Great Patriotic War. The submitted documents contain information on the organization of mobilization and air defense, the geography of the partisan movement, the evacuation and activities of hospitals, the restoration of various objects destroyed during the war and etc.

Results and Discussion. The farther those war years are, the more clear the greatness of our ancestors' feats in our destinies becomes. They won the world-historical Victory over fascism. Our grandfather Mikhailov Ivan Anisimovich played his role in the history of the Fatherland as well. He served in the 1031st rifle regiment of the 280th rifle division in western Germany. From 27.06.1945 till 1947 he was in the 6 front brigade [3].

The allied offensive from the 8th of February to 21st of March 1945 ended with an emergence near the Rhine. On the South of the Ruhr, the 6th and 12th Army Groups reached the Rhine, which captured two bridgeheads on the right bank, creating favorable conditions for an offensive deep into Germany. The 21st Army Group was to the west and north of the Ruhr.

The situation that had developed by the end of March on the Western Front was favorable for the Allies. German troops, which suffered heavy defeats in the Meuse-Rhine and Ardennes operations, and any losses when retreating from the left bank of the Rhine, were weakened. The fighting spirit of the German soldiers was broken. Ruhr industrial region as the most important military-industrial one in Germany was captured by American troops. Germany's ability to continue the war depended on this. Lack of funds did not allow the Wehrmacht command to create a solid defense on the Western Front.

On the 11th of April International Day of liberation of the Nazi concentration camps is celebrated. It is a memorable date. In March 1945, on the territory of Buchenwald (the largest concentration camp) flashes armed insurrection organized by international forces prisoners themselves. "When Buchenwald concentration camp includes the American troops, the rebels had already presided over a death camp. The Nazis did not manage to cover up the traces of their horrible crimes and the testimony of prisoners reached the international Nuremberg Tribunal" [5, www].

Buchenwald (literally 'beech forest') was a Nazi concentration camp established on Ettersberg hill, Germany, in July 1937. It was one of the first and the largest of the concentration camps within Germany's 1937 borders The first internees were actual or suspected communists.

Our grandfather, Ivan Mikhaylov, was Buchenwald and Dachau prisoner from the first day of war till the liberation by the United States Army in April 1945. After his release, Ivan Anisimovich swore allegiance and fought as a machine gunner in the anti-aircraft company of the 1031st rifle Oder order of Bogdan Khmelnitsky regiment (photo 1).

The division was formed in December 1941 as the 280th Infantry Division, it also included 1031st rifle. In the spring of 1942, the 280th Rifle Division was transferred to the 48th Army of the Bryansk Front. It took up defensive positions in the area of the Russkiy Brod railway station on the Oryol-Livny line, defending the road to Yelets. At the end of 1942, the 280th Rifle Division took part in breaking through the Nazi defensive fortifications in the Livny region and in offensive operations near Kursk.

The site *"Memory of the People 1941-1945"* contains documents describing the combat path of the 208th rifle division of the 1031st rifle regiment (photo 2). The period from 25.12.1941 to 09.05.1945, combat

reports are included. Date of creation of the document is: *05/09/1945 Archive: TsAMO, Fund: 1578, Inventory: 0000001, File: 0015.*

The Red Army offensive in April 3, 1945 is described in detail, where machine gunner Mikhailov Ivan Anisimovich made his feat.

Brandonburg, the central province of Germany, was the scene of the victorious offensive of the Red Army. The German population, who fled to the west in the beginning, returned to the east. They captured the center of Germany's war industry – the Ruhr region. The fascist army was expelled from Prussia, the Rhineland and Pomerania [2].

"In the spring days of 1945, the end of the Second World War approached. The troops of the 1st Ukrainian Front were preparing for the final blow. Parts of the division, having received an order from the commander of the 27th corps, replaced the 117th Guards Division and on the night of April 3 went to the front line in the Muskau-Gross-Zerchen area. In the morning, German submachine gunners, faust patrons, with the support of a self-propelled cannon, attacked the outposts of the 2nd rifle company of the 31st regiment" [2, www].

The 1st platoon under the command of junior lieutenant Sarkisyan was in the outposts. The German self-propelled gun was direct fire in the trenches, the faust patrons were burning with fire, the submachine gunners were firing concentrated fire.

"Fearless warriors repelled the superior forces of the Germans. Machine gunner Mikhailov and Shustas fired to the last bullet. Bleeding out, sergeants Yakimchuk and Krasnobor fought. They died, but did not leave. 6 people remained from the platoon. The Germans burst into the trenches, but were soon knocked out by the ripe fighters" [2, www].
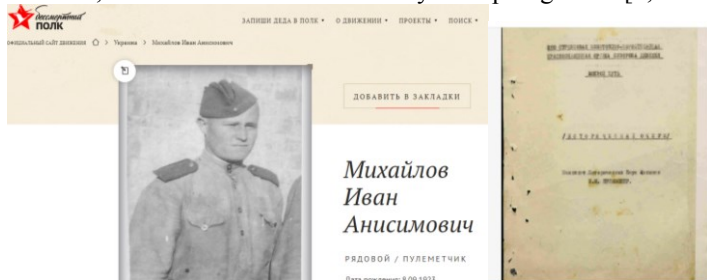
Photo 1– I.A.Mikhaylov   *Photo 2 – Combat path of the 208th rifle div.*

It is possible to establish the fate of relatives who took part in the Great Patriotic War or information about awards, to get acquainted with the original archival documents containing information about the course of the war using the portal "*Memory of the People 1941-1945*".

Conclusion. The historical memory of the Great Patriotic War is fundamental for the development of spirituality, citizenship and the

formation of patriotism. We must keep in our memory the Soviet soldiers' exploits, because it is our history that is an integral part of patriotic education. Our task is to keep memory of the past for our descendants [5].

Remember and do not forget your honest family. We remember! We are proud!

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Аннотация. Описан один из героических дней 1031 стрелкового полка. После освобождения союзниками наш дедушка, Михайлов Иван Анисимович, воевал в 1031-м стрелковом полку. Представлены архивные материалы, описывающие боевой путь 208 стрелковой дивизии.

Ключевые слова: Великая Отечественная война, 1031-й стрелковый полк, 208 стрелковая дивизия, «Память народа 1941-1945».

Annotation. One of the heroic days of the 1031st Infantry Regiment is described. After the liberation by the allies, our grandfather, Mikhailov Ivan Anisimovich, fought in the 1031st rifle regiment. Archival materials describing the combat path of the 208th rifle division are presented.

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RELIGIOUS-PATRIOTIC EDUCATION OF YOUTH

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Introduction. Religious and patriotic education of the younger generation in Russia is an integral part of the development of modern Russian society, the purpose of which is to preserve traditions, culture and family values [9]. The national culture of Russia, as the basis for the spiritual and patriotic education has a high potential. Patriotic education both took a special place in the formation and development of society, and was the most important factor in various spheres of its activity [1]. The patriotic spirit of the Russian people, uniting the hearts of people in the most difficult times, is the most important factor in the development of Russian culture, society and state.

The development of the idea of Russian patriotism is possible with constant communication with nature, art, literature and, of course, in communication with God [2]. The family is an important aspect of this development, since the relationship to faith, work, homeland, people and society depends on relationships in the family. Early introduction to the origins of Russian culture through a lullaby, fairy tale, song, biblical parable indirectly, unobtrusively forms the most valuable spiritual qualities of the personality [3]. "To love the country, to feel its interests, needs, first of all, depends on the formation of social consciousness and feelings, which are formed by individual psychological experiences. The success of a society depends on the multifaceted activities of its members, on the spiritual wealth and feelings of each individual" [5, p. 993].

Materials and Methods. The upbringing of modern Russian society in the spirit of religious and patriotic upbringing, first of all, must begin in the family and educational institutions. We must present an example of respect, devotion and love for our Motherland, family, and God. It is necessary to conduct a lot of practical and theoretical study in this area. The Sense of Patriotism as an Important Factor in the Formation of National Unity was considered by F.R. Abdurakhmonov Z.E. Abdurakhmanova [5], J.C.D. Clark [6], Zhengisbek Tolen, Slushash Tulenova, Elnura Assyltaeva, Nurken Aitymbetov [11] and others. Culturological understanding of religion, patriotism, Orthodox religion and education aspects were studied by Tobias Köllner [12]. Religious education programmes were presented by Tse Thomas Kwan-choi [10].

In the study reported here, a qualitative approach was used to understand the values, goals, and expectations of Religious and patriotic education programs connected with patriotism. :At the current time, there is so little information available about the philosophical bases, and favored practices, of church-based schools that it is impossible to speculate on the nature of possible tensions" [7, www].

Results. Religious and patriotic education of children and youth should be one of the priority areas of activity of state institutions, which is determined by the idea of education based on religious, folk and patriotic traditions.

The essence of such upbringing is determined by the need for the creative development of the personality of young people in love for the Motherland, God and everything human, as well as the interests of society in spiritual development, and to the problems solved by the state.

The purpose of this article is to determine the place and role of religion in the religious and patriotic education of the younger generation.

The formation of patriotism in a society and state as a whole is directly related to the way of life, worldview and faith.

The main value of personality education on the basis of religious-patriotic education is the predominance of the spiritual principle over the material aspect of life, as the improvement of the soul perfection [1]. The need to restore primordial Russian culture and patriotism was emphasized by Moscow and All Russia Holiest Patriarch Kirill: "I see no other way for the spiritual revival of our people, except to transfer the religious factor exclusively from the sphere of folklore and culture into the sphere of real reflections, into the sphere of real creativity, so that religious truths help a person to cope, including with crisis phenomena ... To preserve ourselves, country, cultural identity, so that we are not crushed by the information flow, we must learn to match our beliefs with reality" [1, p. 3].

One should consider the system of religious and patriotic education of children and youth. This one supposes the upbringing of youth in the spirit of patriotism and love for the Motherland, historical events, for example, the exploits of our ancestors during the Great Patriotic War [8].

Religious and patriotic education can be expressed in the form of a ramified system that includes various links, structures, and organs, all the variety of ways, forms, methods and means of carrying out this activity.

The organization of the entire system of religious and patriotic education of the younger generation is necessary at all levels of preschool, family, school, vocational education, in work collectives, as well as at the level of local self-government bodies, in ministries, departments, etc.

The system of religious and patriotic education includes:

1. Formation and development of socially significant values in the process of education and training in different institutions, in general and higher education, in other types of educational institutions. These are patriotism, love for the Motherland, family, hard work and other personality's skills through special events (extracurricular activities, cultural outings, volunteer assistance to the elderly, disabled and needs, etc.).

2. Support for patriotic, religious, including military-patriotic work, by state and public organizations, authorities and administration, social movements and youth organizations (patriotic and military-patriotic, cultural-historical and military-historical, military-technical and military-sports and other clubs and associations, various sections; clubs, days of patriotic work, memory watches, search activities, military sports games, hiking, etc.) [4].

3. Involvement in this work of the media, creative unions, especially workers of culture and art, relevant scientific, youth associations, etc.

4. Interaction of preschool institutions, general education and higher schools with religious organizations in order to strengthen national, cultural and confessional relations in society.

5. Carrying out activities in conjunction with religious organizations, and participating in the implementation of socially significant programs and projects.

Conclusion. It should be said that the religious and patriotic education of youth capable of serving the Motherland with faith and truth in the future is the primary task of modern society. The main approach in solving the set tasks is to educate the younger generation of traditional values based on religion, faith, spirituality, love for their homeland, family and God. To revive the system of religious and patriotic education of youth, it is necessary to unite all the forces of public institutions, educational and religious organizations, with the participation of the church, army and state.

An essential role in the formation of the religious and patriotic education of youth plays literature, history, music, painting, education, as the basis of a full-fledged society.

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Аннотация. Рассматривается формирование системы национальной политики религиозно-патриотического воспитания в современном российском обществе. Делается вывод, что требуется реализация программ религиозно-патриотического воспитания детей и молодежи, а также стратегия развития воспитания в организациях образования.

Annotation. This article states the formation of the system of national policy of religious and patriotic education in modern Russian society. Religious-patriotic education basics of youth are analyzed. It is concluded that it is necessary to implement programs of religious and patriotic education of children and youth, as well as a strategy for the development of education in educational organizations.

Ключевые слова: государственная политика, патриотизм, национальная идея, русский народ, религиозно-патриотическое воспитание.

Keywords: national idea, patriotism, state policy, modern Russian society, religious and patriotic education.

SECTION 4: MARINE TECHNOLOGIES

UDC 656.614

DIGITAL TECHNOLOGIES IN MARITIME TRANSPORTATION

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1. Introduction

Digital technologies are increasingly implemented in various sectors of the world economy. There is no doubt that cargo transportation (sea transportation,particularly) is a very important logistics link for various industries. Therefore, the process of digitalization directly affects the shipping industry. But it should be noted that in the shipping industry, the way of implementation of relevant technologies, associated with the process of digitalization, is going with careful steps. Both carriers and freight forwarding companies are increasingly taking measures to transfer internal processes to digital technologies, develop an integrated infrastructure based on information technologies and ensure the availability of real-time information about the cargo. New companies appear in the digital technology sector, such as Xeneta, Flexport, and Containers (McKinsey and Company, 2017b). Their proposed solutions are designed to provide easy-to-use online interfaces for shippers, while facilitating processes and

increasing transparency. The latest developments related to blockchain technology aimed at facilitating maritime transport are also important.

2. Main part

Despite of the crisis phenomena that recently occur in the world economy (including that part which was caused bythe spread of a new corona virus infection), the cargo turnover on sea transport continues to grow steadily. Figure 1 shows a diagram illustrating the turnover of sea transport by type of cargo in 2020. There is no doubt that the growth of trade turnover seriously increases the burden on the work of ports and a port management system.

One of the trends that is developing at an accelerated pace and can have serious consequences for the operation and management of ports is the spread of digital technologies. There is no universally accepted definition of the digital economy. Recent advances in digitalization are the result of a combination of technologies that are increasingly being applied in mechanical systems, communications, and infrastructure (UNCTAD, 2017b). Innovations such as the Internet of Things, robotics, automation, artificial intelligence, unmanned vehicles and equipment, and blockchain technology play a key role in the spread of digital technologies in maritime transport.
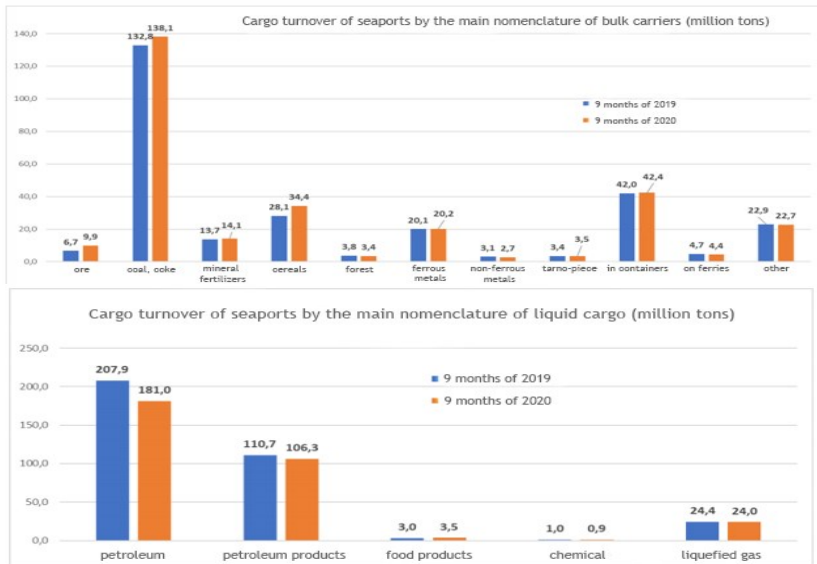
Figure 1 – Diagram of the turnover of sea transport by type of cargo

The application of such innovations in ports covers all aspects of port operations, including the operation, planning, design and development and maintenance of infrastructure [3]. Appropriate technologies can help optimize the movement of ships and cargo, improve the efficiency of operations, make processes more transparent and speed up and automate them, and reduce inefficiencies and errors. Specific examples of how innovative technologies are likely to affect ports include changes in loading and unloading operations (machine-to-machine communication, platform solutions, robotics, the use of smart technologies for port capacity development and mobile workforce), warehouse operations (big data analysis methods, smart meters and unified representation of stored cargo information), and facility operations (smart power grids, smart energy management, three-dimensional printing, safety analysis and preventive maintenance).

At the present, Russian ports handle up to 80% of foreign trade cargo, which ensures the country economic and foreign trade development [2]. And also, the one of the feature of the activity of Russian seaports is an uneven distribution of the cargo transshipment across the sea basins, which is due to both geographical factors and the peculiarities of logistics routers [4].

Comparative charts of the cargo turnover in 2019-2020 by basin and by direction are shown in Figure 2 [1].
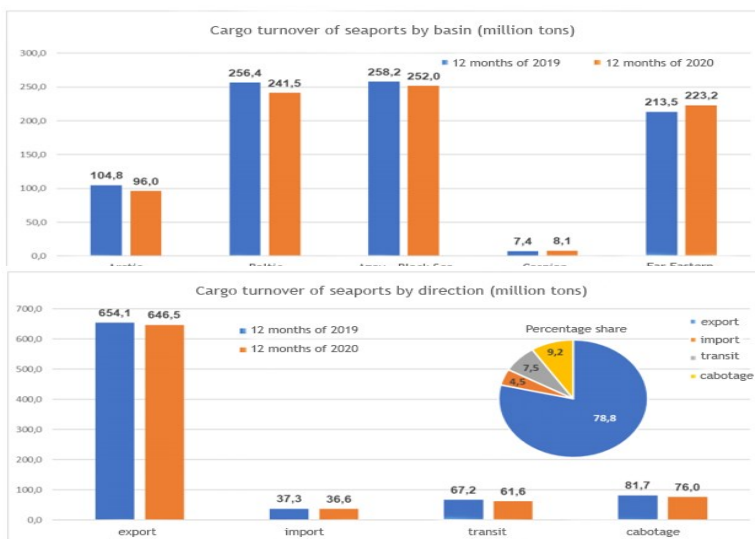
Figure 2 – The cargo turnover in 2019-2020

3. Conclusions

In general, the various technological advances, which can be applied in ports and terminals, allow stakeholders in the port community to innovate and gain additional benefits in the form of increased efficiency and productivity, improved safety, and enhanced environmental protection. For the effective usage of advantages of digital technologies in ports, it will be necessary to monitor and solve various problems. These include the possible regionalization of production and trade models related to robotics and 3D printing, potential implications for the labor market, regulatory changes, and the need to adopt common standards, in particular in the application of blockchain technology and data analysis.

Accordingly to the discussedpreviously, it should be noted that the prospect of the development of Russian seaports is assumed as the way towards the creation of "smart ports" based on the use of various digital technologies (the Internet of Things, artificial intelligence, 3D printing of spare parts, virtual and augmented reality, digital twins, technologies for maintaining distributed registers of accounting and certification of rights, technologies for self-executing codes for fulfilling obligations, drones, etc.), which will create a completely new logistics.

At the same time, it should be borne in mind that the choice and implementation of digital solutions in the activities of seaports is a transformational and complex process that can be either disruptive or transitional. The impact of the transition will depend on the nature of the business processes resulting from the adaptation of technologies in the sector.

Most importantly, the issues related to the digital interaction of seaports with other subjects of the transport space should be taken into account in order to ensure the synchronization of their activities in various aspects: organizational, personnel, legal, financial, technological, security, and others.

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Аннотация. В статье рассматривается влияние роста товарооборота в судоходной отрасли на процесс внедрения цифровых технологий в морских портах.Проведен анализ грузооборота морских портов Российской Федерации в 2019 – 2020 гг. по основной номенклатуре сухогрузов и наливных наливных грузов. Приводятся временные диаграммы грузооборота морских портов по бассейнам и направлениям. На основе проведенного анализа делается обоснованный вывод о том, что перспективой развития морских портов России является создание «умных портов» на основе применения различных цифровых технологий (интернет вещей, искусственный интеллект, 3D-печать запасных частей, виртуальная и дополненная реальность, цифровые близнецы, технологии ведения распределенных реестров учета и удостоверения прав, технологии самоисполняемых кодов выполнения обязательств, дроны и др.), что позволит создать абсолютно новую логистику.

Ключевые слова: интернет вещей, робототехника, автоматизация, искусственный интеллект, беспилотные транспортные средства и оборудование, технология блокчейн, виртуальная реальность.

Annotation. The article examines the impact of the growth of trade turnover in the shipping industry on the process of introducing digital technologies in seaports. The analysis of cargo turnover of seaports of the Russian Federation in 2019-2020 by the main nomenclature of dry cargo and liquid bulk cargo is carried out. The time diagrams of cargo turnover of seaports by basins and directions are given. Based on the analysis, a reasonable conclusion is made that the prospect for the development of Russian seaports is the creation of "smart ports" based on the use of various digital technologies (the Internet of things, artificial intelligence, 3D printing of spare parts, virtual and augmented reality, digital twins, technologies for maintaining distributed registers of accounting and certification of rights, technologies for self-executing codes for fulfilling obligations, drones, etc.), which will create a completely new logistics.

Keywords: Internet of Things, robotics, automation, artificial intelligence, unmanned vehicles and equipment, blockchain technology, virtual reality.

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DIESEL FUEL IN SHIPBUILDING:ADVANTAGES AND DISADVATAGES, SAFETY PRECAUTIONS

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Diesel fuel is a carbon-based oil product that is obtained by distillation after the selection of individual fractions from the oil.

The main indicator of diesel fuel is the cetane number. It indicates the flammability in the engine cylinder. The average for any fuel is from 40 to 50 degrees C. If the cetane number is low, then the pressure in the motor chamber increases, and it quickly wears out. If the cetane number exceeds the 50° mark, this leads to smokiness and high fuel consumption.

Compared to gasoline engines, the main advantage of diesels is high fuel efficiency. They consume 30% less fuel; this partially compensates for a large share of the mass of the engines themselves in the power plant. In addition, diesels have a lower toxicity of combustion products. They emit almost 10 times less carbon monoxide, 2.5 times less hydrocarbons, and 10-15% less nitrogen oxides. However, the exhaust gases of diesel engines contain more soot-solid unburned carbon particles, which significantly increases the smokiness [1].

The MARPOL Annex VI contains provisions allowing for special "SOx Emission Control Areas" with more strict requirements for control on sulfur emissions. In these areas on year 2000, the sulfur content in fuel oil,used on board ships, was allowed to 1.5% m/m (MARPOL 2009) [5].

Diesels are engines with internal mixing and self-ignition from compression, which occur in a very short period of time, corresponding to the time of rotation of the crankshaft by only 20-25°. In comparison with carburetor engines, in diesels at the same speed of rotation of the crankshaft, the time for mixture formation and combustion is allocated 10-15 times less.

The corrosion activity of diesel fuel depends on the content of water-soluble (mineral) acids and alkalis, organic acids, sulfur compounds and water. The hydrocarbons that make up the fuel do not have a corrosive effect on metals. As in gasoline, diesel fuel should not contain substances

that have an acid reaction and cause severe corrosion of metals. Diesel fuel, which is heavier in composition than gasoline, has an increased hygroscopicity [2]. Water trapped in the fuel remains in its thickness for a long time and is deposited slowly, causing corrosion of the fuel equipment. The most severe corrosion during engine operation is caused by sulfur compounds contained in the fuel. Active sulfur compounds are removed during fuel production during the purification process. The fuel contains sulfur compounds that do not directly affect metals, but when they are burned, acid oxides are formed, the most active of which is sulfur anhydride [4].

Forced high-speed diesels are most susceptible to sulfur corrosion. With an excess of oxygen and a high temperature, sulfur dioxide turns into sulfur, causing more intense gas corrosion of the exhaust valve plates, the upper part of the cylinders, the upper compression ring and the exhaust system. In low-voltage diesel engines, when the coolant temperature is low, conditions arise for vapor condensation and the appearance of liquid corrosion, in which the bearing liners are more destroyed. Sulfur is harmful not only from the point of view of corrosion wear, but also the ability to form a solid and dense carbon deposit, the particles of which, getting into the oil, increase the wear of parts and cause the occurrence of piston rings [3].

As in carburetor engines, in diesels, the intensity of accumulation of resinous substances, varnish deposits and carbon deposits depends on the quality of the fuel and engine oil used. The accumulation of high-temperature deposits in the combustion chamber, on valves and other parts causes the engine to overheat, reduce power and degrade efficiency. When the holes of the nozzles are coked, the fuel atomization deteriorates, its supply decreases or completely stops [2].

Diesel fuel contains more resinous compounds than gasoline, which contributes to incomplete combustion. The amount of tar in the fuel has a significant impact on the engine service life. If it meets the requirements of the standard, long-term reliable operation of the diesel engine is ensured, and if the resin content is two to three times higher than the norm, the engine life can be reduced by 40-50% [4].

The ash formed after the combustion of the fuel is a mineral residue. It not only contributes to the formation of carbon deposits, but also increases engine wear.

The gaps of precision pairs of high-pressure fuel pumps are only 1.5-2.5 microns, so even a small amount of mechanical impurities in diesel fuel causes their wear. Especially harmful are abrasive contaminants of the crystalline structures, namely quartzites and alumina, which have a high

hardness; they can get into the fuel tank during careless transportation and storage of fuel. For high-speed diesels, fuel containing mechanical impurities, even in a negligible amount, is unsuitable [1].

Diesel fuel belongs to the substances of hazard class 4 (low-toxic). It irritates the mucous membrane and human skin, the maximum permissible concentration of fuel vapor in the air of the working area is 300 mg/m3 [2].

Containers in which fuel is stored and transported must be protected from static electricity.

When working with fuel, no tools that give a spark on impact should be used. If a fire does occur, one can use sprayed water and foam to extinguish it; for volumetric extinguishing — carbon dioxide, the composition of LPG, the composition of 3.5 and superheated steam [3].

Changing of standardsfor diesel fuel quality are primarily related with more stringent environmental requirements (for example, the transition to ISO 8217:2010) [5].

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Аннотация. В статье затрагивается речь о топливе, способствующем экономии, экологичности. Подчеркивается рост использования дизельного топлива, в том числе всудовых энергетических установках, во всех странах мира.

Ключевые слова: дизельное топливо, экономия, дизель, мощность, клапаны.

Annotation. The article touches on the topic of fuel that contributes to economy and environmental friendliness. The increase of use of diesel fuel worldwide, especially in marine power plants,is pointed out.

Keywords: diesel fuel, efficiency, diesel, power, valves.

DEVELOPMENT OF AN ADAPTIVE METHOD FOR IMPROVING THE NOISE IMMUNITY OF SHIP COMMUNICATION SYSTEMS

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Introduction

In some cases, "the reception of information through channels with time- ranging characteristics is followed by unacceptable losses in the quality of operating communication systems" [4, p. 134]. "Adaptive and robust methods are used to reduce the indicated dependence of the effectiveness of these systems on the current quality of the channel used" [2, p. 14], which are sometimes insufficiently justified in opposition to each other [5, p. 168]. Therefore, the purpose of this article is to study the conditions and features of ensuring the robustness of adaptive methods for the case of receiving digital information on dispersive communication channels. "The robustness of the system implies its roughness and quasi-optimality, as well as the comparative simplicity of technical implementation" [3, p. 120]. It follows that if the optimal signal reception algorithm is incorrect, its Tikhonov regularization is required, which is "accompanied by a certain decrease in the speed of information transmission over the radio channel" [5, p. 82].

Main part

At the same time, the "roughness" of the system and "simplification of its hardware implementation are provided by the price of the introduction of some final value of the permissible mistake E_{dop}, that is" [1, p. 156]

$$I = N_p \Phi\big[h(t)\big] + \overline{E^2_{dop}}, \qquad (1)$$

where $h(t)$ — pulse transition function of the system;

$\Phi[.]$ — selected functional quality;

N_p — functionality whose minimization determines the solution of the optimal synthesis problem;

the line at the top is an averaging sign, and $\overline{E^2_{dop}} > 0$.

Obviously, in expression (1), "regularization noise" acts as a Lagrange multiplier. This implies the statement that the information transfer rate of an arbitrary robust system is strictly less than the information transfer rate of an optimal system built in accordance with an incorrect (i.e. unregulated) algorithm.

For example, limiting the reception band of discrete signals in the implemented systems leads to the appearance of inter-character distortion (MSS), which is "a physical analog of 'regularization noise'" [2, p. 36]. "This significantly limits from above the almost achievable transmission rates of digital messages over communication channels with a finite bandwidth due to deterioration of their reception conditions" [3 p. 38]. It is also known that the most effective ways to reduce the impact of MSS are based on the use of adaptive methods of compensation (suppression) of the latter [1, p. 101]. At the same time, the conditions for applying data and other adaptive methods are the adequacy of statistics of the results of evaluating the current values of the relevant characteristics of the channel used and (or) parameters of the useful signal and interfering signals and noise, as well as high speed of monitoring devices and adaptation loops (adjustment, reorganization, etc.) "while maintaining the stability of the latter in the entire operating range" [3 p. 102]. In this case, the adaptive system is also robust, i.e. its average (guaranteed) efficiency is higher than that of arbitrary deterministic systems. This is reflected in the proposed classification of adaptive systems, which is presented in table 1.

It should be noted that with increasing speed of receiving and transmitting information, that is, with the transition to ultra-high-frequency (microwave) and extreme high-frequency (EHF) bands, the expediency of using adaptive methods in radio receivers (RR) increases. Indeed, "the time characteristics of fading in linear dispersing channels are invariant to the message transmission rate and other parameters of transmitted signals" [5, p. 140]. Therefore, with an increase in the speed of information transfer, there is a rapid increase in the "duration' of error packets, the appearance of which is due to the influence of the above-mentioned fading. The use of adaptation theory methods to increase the noise immunity of RR is even

more justified and appropriate, because "increasing the speed of information transmission is associated with the need to use higher-frequency (and, consequently, more non-stationary in time) channels with rather limited opportunities for creating a sufficiently large energy 'reserve'" [4, p.76].

Table 1. Classification of adaptive systems

Adaptation object	Signal receiver; Signal transmitter; Signal propagation environment; Combined	Need to enter a special channel feedback
Control object	Received signal; Signal transmission channel; Quality of received information (useful messages); Combined	
Adaptation objective	Optimization of signal reception quality; Stabilization of signal reception quality; Combined	Maximizing usefulness; Minimizing losses; Stabilization usefulness; Stabilization losses
Degree of adaptation	By the speed of information transfer with the specified quality; By the quality of information transmission at a provided speed; By spatiotemporal processing of electromagnetic waves; By receiving and / or transmitting signals; By processing (selecting an information portrait) – signals in the modem; By information processing software in the codec; Combined	
Depth of adaptation	Small $_{\|(\Delta/\delta)\|<<\|\delta\|}$ Average $_{\|(\Delta/\delta)\|\sim\|\delta\|}$ Big $_{\|(\Delta/\delta)\|>>\|\delta\|}$	
Amount degrees of freedom control	Single-parameter control; Multiparametric control	
Quality degrees of freedom adaptation	Single parameter adaptation; Multiparametric adaptation	

In addition, the increase in the speed of message transmission is usually accompanied by the expansion of the potential for operational monitoring of the current state of the channel used (the quality of information processed or the values of parameters of received signals). "This is due to fact that to ensure sufficient statistics of the results of this control requires a fixed and invariant to the transmission rate of the number

of independent responses (measurements)" [4, p. 181]. Thus, with an increase in the speed of information transmission (and therefore with a decrease in the duration of the clock interval), the period of time required for reliable control is reduced, that is, the efficiency of this control increases. We also note that an increase in the information transmission rate and the associated increase in the frequency range used makes it possible to expand the dynamic range of adaptation in many parameters (spatial, frequency, etc.) of the transmitted signals and in the transmission rate itself. Thus, as the speed of information transmission increases, the flexibility increases and the functionality of adaptive communication systems expands.

In general, we can write:

$$R \uparrow, \Rightarrow \overline{N_n} \uparrow, (\Delta / \delta) \uparrow, \Delta \mathrm{T}_k,$$

where $\overline{N}_n$ — average error packet length, and $\overline{N}_n = \Delta \overline{t}_3 / \Delta t_T$;

Δt_3 — the average duration of fading, which is not less than a certain threshold, which is characterized by a high probability of correlated mistakes;

Δt_T — the duration of the clock interval, the value for a given modulation method (and the method of encoding discrete) is inversely proportional to the value of the information transfer rate R;

ΔT_k — the period of time required for reliable monitoring of the current state of the channel used and / or parameters of the useful signal and interfering signals, as well as noise or the quality of received information, and $\Delta T_k = \Delta t_T \cdot M_\delta$;

M_δ — necessary to ensure sufficient statistics of control results $(M_\delta > 1; M_\delta \in N)$;

N — set of natural numbers;

(Δ / δ) — dynamic range of adaptation;

Δ — the scope of the conversion;

δ — working area, $(\delta \cap \Delta = \delta; (\Delta / \delta) \neq \Omega)$;

Ω — empty set.

At the same time, it should be noted that as the speed of information transmission increases, the real possibilities of organizing inertia-free (weakly inertial) feedback channels in radio lines of a given physical length decrease. In addition, the practically achievable speeds of adaptive adjustments (adjustments) are limited by a number of fundamental and technical limitations. First of all, this applies to the so – called "smooth" adjustments-adaptation in continuous time with a continuous set of values (states) of the tunable parameter. In particular, the duration of transients in

monitoring and regulating devices, as a rule, should be significantly less than the duration of the elementary clock interval. Therefore, to build high-speed adaptive communication systems with information transmission rates of 100-110 bps, "tunable elements with gigahertz response rates are required, which are currently implemented only on the basis of ultra-fast digital switch circuits" [1, p. 142].

It also follows that the use of feedback is possible only in cases where the doubled delay in the propagation of signals from the transmitter to the receiver does not exceed (or significantly does not exceed) the duration of the information clock cycle. Taking into account the defining role of the features and capabilities of hardware implementation broadband and (or) high-speed elements of the microwave and EHF bands, the following main features robust adaptive high-speed RR Radio-Technical spacecraft control systems can be formulated [1, p. 146]:

– the preferred object of adaptation is a signal receiver (especially for high – speed digital communication channels with a sufficiently large physical length);

– it is advisable to use higher hierarchical levels of adaptation (at the level of the demodulator and decoder), where it is easier to make adjustments with a sufficiently high speed;

– the most preferred are self-adjusting and, especially, adaptive systems for high-speed transmission of digital information, self-organizing;

– it is advisable to use "open" inputs of the "consulting" type with "soft" decision-making on the results of monitoring external actions;

– it is advisable to control and/or adapt in discrete time with a counting (usually finite and, preferably, binary) set of values of controlled parameters and tunable States.

Conclusion

Based on the above, we will develop a method for increasing the noise immunity of the receiving device, taking into account the features of adaptive systems. Therefore, we will consider the features of the radio control line and develop a method based on synchronous tuning of the receiving and transmitting path to maintain a given value of the signal-to–noise ratio on the receiving side and use adaptive demodulation of information signals with compensation for nonlinear distortion.

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Аннотация. Для приема-передачи сообщений и информации, а также для координации действий с компетентными организациями и должностными лицами при угрозе нарушения охраны судна используются средства судовой радиосвязи, в том числе Глобальная морская система связи при бедствии и для обеспечения безопасности (ГМССБ). Связь осуществляется по судовой (судовой-земной) радиостанции через сеть береговых (береговых земных) радиостанций, входящих в систему радиосвязи морской подвижной (морской подвижной спутниковой) службы в форме радиосообщений (факс, телекс, E-Mail), радиотелефонных переговоров, в том числе по спутниковым каналам связи и т.д.

Ключевые слова: помехоустойчивость, системы связи, адаптивные методы, каналы связи.

Annotation. Ship radio communications, including the Global Maritime Distress and Safety Communications System (GMDSS), are used to receive and transmit messages and information, as well as to coordinate actions with competent organizations and officials in the event of a threat to the security of the ship. Communication is carried out over the ship's radio stations through a network of coastal radio stations within the radio system-the Maritime mobile (Maritime mobile-satellite) services in the form of radio messages (Fax, telex, E-Mail), radio talks, including satellite communications, etc.

Keywords: noise immunity, communication system, adaptive methods, communication channels.

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FASTSHIP'S FLEXIBILITY IN DESIGNING MARINE STRUCTURES

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Introduction. It is a great engineering challenge to design new ship systems that make future shipping a more efficient, safe and environmentally friendly transportation means than it is today [9]. Ship designing is a process of synthesis bringing together a wide range of disciplines and analysis methods.

Most design problems may be formulated as follows: determine a set of design variables (e.g. number of ships, individual ship size and speed in fleet optimization; main dimensions and interior subdivision of ship; scantlings of a construction; characteristic values of pipes and pumps in a pipe net) subject to certain relations between and restrictions of these variables (e.g. by physical, technical, legal, economical laws).

Virtual Reality Technology, Augmented Reality and their prospects present current trends in shipbuilding and ship designing [2, 5-7]. Technological innovations are the key driving forces shaping the future. Recent examples are self-righting lifeboats, 3D printing, Hardware-in-the-Loop simulations and electric dredge pumps. Ship designing was studied by Adrian Biran, Rubén López-Pulido [1], Eric C. Tupper [12], Harry Alexander Karanassos [8], Yong Bai, Wei-Liang Jin [3].

Suresh Chandra Misra discussed stability issues relevant to ship design, as well as hydrodynamic aspects of resistance, propulsion, sea keeping and maneuvering, and their effects on design [10]. The determination of hull form from the data of systematic hull form series and the detailed description of the relational method for the preliminary estimation of ship were considered by Apostolos Papanikolaou.

The purpose of this article is to study perspectives of FastShip – a powerful program for designing hulls, superstructures, appendages, and other marine structures, with the ability to design fair surfaces quickly and accurately. Virtual Reality is a really effective way to finalize design parameters before construction starts.

The main part. It is possible for multiple users to simultaneously access the simulated Virtual Reality environment that creates opportunities for interactions within a virtual ship. Augmented Reality digitally enhances one's regular 'view' of a situation [13]. "These AR images of real-time and real-world situations can be used for physical space measurement and environmental recognition" [13, www].

In the design of all types of vessels FastShip is used, and it can produce new hulls automatically from a set of parameters: ship type, displacement, overall dimensions, LCB, and form coefficients from parent hulls included with the system, or customer-created parent hulls. Multiple surfaces can be created in FastShip; intersections can be displayed, and the part of a surface on intersection side can be trimmed away, facilitating the

creation of appended skegs and thruster tunnels. This capability maintains the correct wetted surface and displacement for the hydrostatics outputs (picture 1).
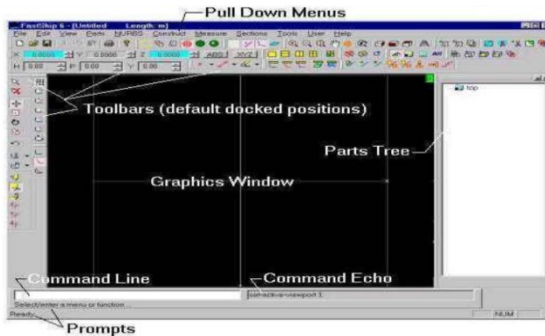
Picture 1 – Fast Ship interface

"FastShip's flexibility allows any hull form type to be represented, and hull features such as bossing, bulbous bows, twin skegs, chines/knuckles, broken sheerlines, and circular bilge turns are readily incorporated into the model" [5, www].

The FastShip user interface has six main components (table 1).

Table 1. Components of the FastShip user interface

Component	Features
Pull Down Menus	All functions are available through the pull-down menu. Most of these functions are accessible through icons on the toolbars
Toolbars	Toolbars are groups of graphic icons, subdivided by functionality. They can be rebuilt, moved to another location and disabled (using the View / Toolbars menu).
Parts Tree	This pane shows a hierarchical tree view of your model, similar to Windows® Explorer
Command Line	FastShip is basically command driven. This means that every pull-down menu function and every icon in toolbars invokes a corresponding command, which can also be executed via the command line (there are a few exceptions). Some functions performed by means of graphic icons sometimes require additional information to be entered through the command line
Command Echo	When a command is executed, its syntax is displayed in this field. By observing this field, the command language can be learnt
Prompts	When you place the cursor over an icon or menu command, the bottom line of prompts displays a description of that function. The top line displays hints as you execute commands

Source: [5].

FastShip exports "AutoCAD DXF files to create a traditional 3-view lines drawing or to support creation of a general arrangement drawing" [5, www]. This program also has the ability to export and import Rhino 3 and 4 files, containing the intersection curves preservation and trimming. "Other outputs are IDF offset files that can be used by Visual SMP and GHS, as well as GHS's native "GF" format and IGES 128 for use in solid modeling" [5, www].

The process of beginning a new design in FastShip can take one of four basic approaches (table 2).

Table 2. Basic approaches of FastShip

APPROACHES	CHARACTERISTICS
Hull Wizards	Planning hulls and containership-type hulls can be generated in a matter of seconds, by supplying basic information on the overall hull parameters
Parametric variation of a Parent Hull	A parent hull can be modified to fit a set of parameters, including LCB location, block coefficient, length of parallel midbody, overall dimensions, and more using the FastGen macros. The user can create new parent hulls by first creating the surface in FastShip, and adding a simple data file describing the topological features of the surface
Design from Scratch	A new design should be created simply by beginning with a flat NURBS surface, and then modifying the control net into the desired three-dimensional shape. FastShip's many editing tools and real-time display of the surface make this approach surprisingly fast
Fitting an existing set of offsets	In case of re-creation of an existing hull, the offsets of that hull may be entered into FastShip in various formats. For example, station curves in DXF format may be translated into the IDF format, and then read into FastShip. Once the offsets are read in, the surface is generated using one of the previous methods, and then either manually or semi-automatically fit to the offsets

Source: [5].

FastShip analyzes the hull form for fairness, by computing and displaying the curvature of any section or 3D curve. Surface curvature is displayed as a color map, including minimum, maximum, average, and Gaussian curvature.

FastShipis used to determine hydrostatic characteristics and computes hydrostatics in such ways:

– Intact hydrostatics at one or more waterplanes, consisting of sectional area curve;

– Free-float hydrostatics, where the ship designer supplies center of gravity, a displacement, and optionally one or more weights and their centers of gravity, and FastShip identifies the equilibrium flotation condition;

– MaxVCG calculation, where the Maximum allowable VCG is computed in accordance with IMO regulations;

– Rollover hydrostatics, where righting arms are computed at a series of heel angles in a free-to-trim condition;

– Real-time hydrostatics, supplying an interactive sectional area curve as the surface is manipulated, and LCB, displacement, and prismatic coefficient immediately after an editing operation is completed [5].

FastShip has a number of interfaces and data transfers for further work in a CAD system, including:

– IDF, including Section data, NURBS surface data, Mesh data, and Parameter data, for transfers to other programs;

– DXF, both 2D and 3D, for data transfers to CAD packages;

– Output IDF and GF format file for Visual SMP and GHS;

– IGES, for Entity number one-twenty-eight NURBS surfaces, for transfer to many CAD programs such as Intergraph ISDP, MicroStation, AutoCAD Mechanical Desktop, and others;

– Output for SHCP, Pias [5].

Conclusion. The primary FastShip output is the hull shape. FastShip directly outputs lines drawings to the system printer in addition to transferring data to other programs.Offset tables and hydrostatics data are printed easily. They are output in a file format that is incorporated in CAD drawing or a word processor. FastShip imports IGES, IDF, DXF, and GF files [6]. FastShip is a program for designing hulls, superstructures, appendages, and other marine structures, with the ability to design fair surfaces quickly and accurately. It is used in the design of all types of vessels.This presents good prospects for future shipbuilding.

Prospects for further research are issues of various digital technologies effectiveness in the design of ships, their comparison, pros and cons determination.

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Аннотация. В исследовании рассматривается программа FastShip для проектирования корпусов, надстроек, надстроек и других морских конструкций с возможностью быстрого и точного проектирования чистовых поверхностей.

Ключевые слова: FastShip, проектирование корабля, чертеж в трех плоскостях, основной корпус, гидростатические характеристики.

Annotation. The study considers FastShip program for designing hulls, superstructures, appendages, and other marine structures, with the ability to design fair surfaces quickly and accurately.

Keywords: FastShip, ship designing, 3-view lines drawing, Parent Hull, hydrostatic characteristics.

ASSESSMENT OF SIGNALS DISTORTIONS IN TROPOSPHERIC COMMUNICATION CHANNELS OF COASTAL SYSTEMS

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Introduction

The coastal communication system is designedto provide communication for TCSO operators, dispatchers and inspectors of seaport administrations, dispatchers of river information services, unified situational centers, pilotage service dispatchers, coast guard and other users in need of a reliable multi-user USW communication system.

The main part

Recently, the field of application of millimeter radio waves has increased significantly. These are noise-immune communication between ground and space objects and communication in space, telemetry, radar and other areas in which the main advantages of this range can be realized.

When millimeter (MMT) radio waves are used in communication systems, there are a number of additional advantages associated with the peculiarities of their propagation. In particular, the MMT antenna systems of the range with moderate apertures make it possible to create narrow directional beams of radiation, at which a high resolution in angular coordinates is possible. This circumstance makes it possible to reduce the cost of radio relay lines by placing their antennas on existing highways or suitable buildings. The main advantages of the MMT range are the

possibility of transmitting a wide frequency band, which can significantly increase the speed and volume of information transfer and increase the noise immunity of receiving useful signals against the background of interference, which is of great importance in coastal communication systems.

Great opportunities are promised by the use of MMT for communication via satellite in those areas where the creation of conventional radio relay (RRL) and cable communication lines is difficult. Such a communication system is being developed, for example, in Japan, where mountains, ocean, and overpopulation interfere with other forms of communication.

The ability to concentrate energy in a narrow range of angles, large Doppler frequency shifts when reflecting from low-speed objects, ample opportunities for pulse compression create conditions for real compact and noise-immune communication systems. Currently, the cost of solid-state equipment in the MMT range is still high, but it is expected that in the coming years it will be equal to the cost of low-frequency solid-state nodes. All this makes it possible to create reliable and relatively cheap active repeaters. The placement of repeaters, such as the ATS-F, for communication between ground points significantly expands the capabilities of the RRL. AES in a stationary orbit are practically ideal conditions for operation as repeaters of the MMT range.

As shown by numerous studies [2, p.120], the propagation of radio waves of the specified range has some peculiarities that limit the reliability and bandwidth of signals transmitted over real channels. Precipitation in the form of rain and sleet has the main influence on the reliability of the MMT communication lines. The effect, which is almost comparable to the absorption in hydrometeors, is also exerted by the deep interference fading recently discovered in the centimeter range, which, moreover, is not highly selective in frequency. As far as we know, similar fading has not been studied in the MMT range.In addition to the absorption and scattering of MMT in rains and atmospheric gases, when radio waves propagate in real conditions, fluctuations in the amplitude, phase, frequency, polarization, delay time and other parameters of radio signals occur[3, p.38], the coherence of signals is disrupted and their shape is distorted. These factors limit the reliability of radio relay links and the ability to transmit broadband messages over it.

An arbitrary signal x(t) can be written as follows:

$$x(t) = v_0(t)\cos[\omega_0 t + Q_0(t) + Q_0] \tag{1}$$

or, using the complex form of writing

$$x(t) = \operatorname{Re} \widetilde{x}(t)$$

where $\tilde{x}(t) = \tilde{v}_0(t)e^{j\omega_0\tau}$ is the analytical signal,

$\tilde{v}(e) = v_0(t)e^{j\Theta_0(t)}$ - complex signal envelope,

$v_0(t)$ and $Q_0(t)$ – envelope and phase, respectively.

The complex envelope of the signal at the output of the communication channel with time-varying parameters can be found from the relation

$$\tilde{v}(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} H(t,\omega)X(\omega)e^{j\omega t}d\omega \qquad (2)$$

where $H(t,\omega)$ is the transfer function,

$X(\omega)$ is the amplitude spectrum of the signal

To estimate the energy losses of the signal caused by fluctuations of its parameters, and to estimate the effectiveness of the signal duration and bandwidth, we will use the calculation method, in which it is necessary to determine the complex envelope of the cross-correlation function of signals at the input and output of the channel:

$$R(\tau,\Omega) = \frac{1}{4\pi\sqrt{EE_0}}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} H(\omega,t)X(\omega)v^*(t-\tau)e^{j\omega t+j\Omega t}dtd\omega \qquad (3)$$

where the sign * means complex conjugacy, and $\Omega=2\pi F$ is the frequency shift due to temporary changes in the channel parameters, E and $_0$ E0 are the signal power at the output and input of the channel. Let's define the average $\langle$one ....$\rangle$ square of the modulus of the intercorrelation function, assuming that the communication channel is stationary [1, p.203]:

$$\langle|R(\tau,\Omega)|\rangle = \frac{1}{(4\pi)^2 EE_0}\iiint$$

$$\int_{-\infty}^{\infty} B(t'-t,\omega'-\omega)X(\omega)X^*(\omega)v^*(t-\tau)v_0(t'-\tau)e^{j\Omega(t-t')+j\omega t-j\omega't'}d\omega d\omega'dtdt' \qquad (4)$$

After replacing the variables $t'-t\to\Theta$ and $\omega'-\omega\to v$, we find

$$\langle|R(\tau,\Omega)|\rangle = \frac{1}{(4\pi)^2 EE_0}\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} B(v,\Theta)e^{-jv\Theta-j\Omega\Theta}\int_{-\infty}^{\infty} X(\omega)X^*(\omega+v)e^{-j\omega\Theta}d\omega$$

$$\int_{-\infty}^{\infty} v^*(t-\tau)v_0(t+\Theta-\tau)e^{jvt}dt \qquad (5)$$

The time integral in (5) can be rewritten after replacing $t-\tau\to t'$

$$\int_{-\infty}^{\infty}\langle...\rangle dt = \int_{-\infty}^{\infty} v_0^*(t')v_0(t'+\Theta)e^{-jvt'-jv\tau}dt' = 2E_0 R_0^*(-\Theta,v)e^{-jv\tau} \qquad (6)$$

where $R_0(\Theta,v)$ – the autocorrelation function of the complex envelope of the signal. The frequency integral is

$$\int_{-\infty}^{\infty} \langle\ldots\rangle d\omega = 4\pi E_0 R_0^*(\Theta,-\nu) \tag{7}$$

Substituting (6) and (7) into (5), we find

$$\left\langle |R(\tau,\Omega)|^2 \right\rangle = \frac{8\pi E_0^2}{(4\pi)^2 EE_0}$$

$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} B(\nu,\Theta)e^{-j\nu\Theta-j\Omega\Theta-j\nu\tau} R_0(-\Theta,\nu)R_0^*(\Theta,-\nu)d\nu d\Theta \tag{8}$$

Considering that

$$R_0^*(-\Theta,\nu) = R_0(\Theta,-\nu)e^{j\nu\Theta}, \text{ and}$$

$$R_0(\Theta,-\nu) = R_0^*(-\Theta,\nu)e^{-j\nu\Theta}, \tag{9}$$

Given that

$$\left\langle |R(\tau,\Omega)|^2 \right\rangle = \frac{E_0}{2\pi E} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} B(\nu,\Theta)e^{-j\Omega\Theta-j\nu\tau} |R_0(\Theta,-\nu)|^2 d\nu d\Theta \tag{10}$$

Replacing $\nu \to -\nu$ and considering that $B(-\nu,\Theta)=B(\nu,\Theta)$, and $E \cong E_0$, we find

$$\left\langle |R(\tau,\Omega)|^2 \right\rangle = \frac{1}{2\pi} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} B(\tau_1,\Omega_1)e^{-j(\Omega_1\tau-\tau_1\Omega)} |R_0(\tau_1,\Omega_1)|^2 d\tau_1 d\Omega_1 \tag{11}$$

Relation (11) is fundamental for calculating the positions that occur in a communication channel if its parameters fluctuate over time.

Let us take a closer look at the physical and geometric meaning of formula (11). If we assume that fluctuations in the communication channel do not lead to a bias in the estimates for τ and Ω, but only affect the energy losses compared to the optimal reception

$$\left\langle |R(0,0)|^2 \right\rangle = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} B(\tau_1,\Omega_1)|R_0(\tau_1,\Omega_1)|^2 d\tau_1 d\Omega_1 \tag{12}$$

The magnitude of these losses is easy to determine, taking into account that for an arbitrary signal the following condition is always fulfilled:

$$\frac{1}{2\pi} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} |R_0(\tau_1,\Omega_1)|^2 d\tau d\Omega = 1 \tag{13}$$

When the value of the ratio $B_1(\tau_1,\Omega)$ for all values of delays and frequency shifts are equal to 1. In this case, formula (12) turns into (13) and no energy loss occurs. Let us consider the case when the correlation function of the communication channel has the form of a sharp peak at the origin.

Obviously, the value of the interval in this case will differ significantly from unity, since the function $B_1(\tau_1,\Omega)$ has only those values from $|R_0(\tau_1,\Omega_1)|^2$ at which $B_1(\tau_1,\Omega)$ is not lower than a given level. Physically, this means that the signal is scattered in time and frequency, and the receiver, which is optimal for the original signal, turns out to be not optimal for the signal converted in the channel. If we replace the function $|R_0(\tau_1,\Omega_1)|^2$ with an equivalent in volume parallelepiped, in which two dimensions form, respectively, intervals of frequency and time correlation, and the height is equal to 1, the difference of integral (12) from 1 turns out to be proportional to the ratio of the areas bounded by the indicated integrals. Energy losses associated with non-optimal filtering can be conditionally attributed to the narrowing of the effective bandwidth, assuming

$$\mathbf{F_2} = \frac{\mathbf{F_1 P_2}}{\mathbf{P_1}} \quad, \tag{14}$$

where F_1, F_2 are the signal bands before and after the signal passes through, and P_1, P_2 are the powers determined from relation (12). Note that determining the effective bandwidth in accordance with formula (14) may lead to errors in determining the distortion that occurs in the channel. To illustrate, we will give a simple example, when a pulse signal propagates in a channel with a delay that randomly changes in time, and its registration is performed by a cross-correlation receiver. The strobe of the strobe function of the cross-correlation detector should be selected so that the receiver would be the optimal signal arriving at the moment of time $t=t_0$. However, due to the change in the delay in the communication channel, the beginning of the pulse for different arrival times does not coincide with the instant t_0, therefore, the response is caused only by that part of the pulse, the product of which with the strobe function is different from 0. Therefore, the average losses compared to the optimal reception of a burst of pulses increase [4, p.27], and they are not associated with loss of the waveform. These losses will be significant when assessing the accuracy of time delay measurements in radar and radio navigation; they do not restrict the transmission of broadband signals in microwave links.

Conclusion

Thus, the tropospheric communication channel is satisfactorily described by a linear model with constant or slowly changing parameters in time. Knowledge of the impulse transient function or transfer function of the communication channel is a necessary and sufficient condition for calculating the output waveform.

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Аннотация. Развитие и широкое применение спутниковых и тропосферных навигационных систем определило актуальность проблемы защиты навигационных приборовот помех. Специалисты в области судовождения проявляют интерес к таким навигационным системам с целью повышения помехоустойчивости навигационного оборудования.

В данной статье рассматриваются недостатки тропосферных систем.Тропосферная связь имеет ряд преимуществ, основными из которых являются более низкие экономические затраты и более высокая помехозащищенность. Предложен также метод оценки искажений сигнала в тропосферных каналах прибрежных систем.

Ключевые слова: береговые системы, сигналы, тропосферная радиосвязь, радиоволны, радиопомехи.

Annotation. The development and widespread use of satellite and tropospheric navigation systems has determined the urgency of the problem of protection against interference of navigation devices. Specialists in the field of ship navigation demonstrate interest in such navigation systems in order to improve the noise immunity of navigation equipment.

This article discusses the disadvantages of tropospheric systems; tropospheric communication has a number of advantages, the main of which are lower economic costs and higher noise immunity. A method for assessing signal distortion in the tropospheric channels of coastal systems is also proposed.

Keywords: coastal systems, signals, tropospheric radio communications, radio waves, channels of connection, radio interference.

IMPROVEMENT OF RADIO SIGNAL RECEPTION METHODS IN SHIP WEATHER STATIONS

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Introduction

The Marine weather station tool informs about instant changes in the weather. Wind speed and direction are measured by means of ultrasonic transducers. The absence of moving parts increases service life and reliability. Internal temperature and atmospheric pressure sensors help predict changes in weather conditions. Combined with an internal direction sensor, it provides everything you need for navigation. The weather station can provide an accurate course determination of 2° in dynamic conditions, such as rough seas. Dynamic motion correction software is the key difference. The course is very accurate and stable in most sea conditions, even if the ship is rocking and listing at an angle of up to 30° in rough seas.

These ship weather stations, performing a complex of meteorological and hydrological observations, primary data processing and information transmission, can be used on various vessels (from military vessels to small tourist liners, coast guard vessels and research ships, as well as on river transport) [4]. Due to their functional features, ship automatic weather stations allow you to receive a large amount of complex meteorological and hydrological information in the vast seas and oceans.

In addition to standard meteorological parameters, such as air temperature, relative humidity, atmospheric pressure, wind speed and

direction, sensors record water surface temperature, salt content in water, wave height, and are able to measure the degree of visibility. Taking into account the conditions of its operation, the ship's automatic weather station must have a completely sealed structure, a minimum of connections and cables to meet the specific conditions of its operation: strong (storm) wind, rain and fog, salt fog, exhaust gases, etc.

The measurement of wind parameters has its own specifics. While the ship is moving, standing, drifting, or performing any experiment or maneuver, the ship's automatic weather station must determine both true wind characteristics (analogous to measuring wind characteristics at ground stations, where the wind direction is measured from the North direction) and relative wind (relative to the ship). To calculate wind characteristics in all these conditions, the station must receive information from a GPS receiver and a built-in compass without moving parts (GPS for driving and compass for drifting, Parking or other cases when the ship's nose is not directed in the direction of movement). In any ocean there are significant areas of water that are practically not visited by ships or visited rarely and irregularly. This is primarily due to the fact that ships sail along certain sea routes. But for forecasting, it is necessary to receive information about the weather constantly, and observations should be made everywhere, including in the ocean. To correct this situation, buoy automatic weather stations are installed in the oceans and near the coastlines, where there are no other sources for obtaining meteorological information [5].

Compared to the cost of unmanned weather buoys, weather vessels have become expensive, and weather buoys have begun to replace weather vessels. The meteorological work of ocean stations includes an hourly regular program of surface observations and high-altitude ascents using radiosondes and wind radar techniques four times a day. Scientific research, such as recording ocean waves, studying boundary layer problems, and measuring radiation, is carried out depending on the circumstances. This Chapter discusses the composition and properties of the marine atmosphere. The atmosphere consists of a well-known mixture of nitrogen (76-78 percent by volume), oxygen (20-21 percent), argon (0,9 percent) and some other inert gases (in very small percentages), and this substance, although small in volume and weight, plays an important role in many meteorological processes. In addition to being important for meteorological processes at sea, electricity in sea air is also of General interest, since the relevant measurements will reflect conditions that are not disturbed by atmospheric pollution and can therefore be considered natural.

Currently, one of the possible directions is to evaluate the data of meteorological radar signals , including the determination of strong storms

and anomalous propagation. Meteorological radars are specialized radars for storm warning and urban protection, and are also designed to solve the following tasks [1]:

– detecting and locating thunderstorms, hail, and heavy rain within a radius of ~300 km and measuring their physical characteristics;

– determination of the horizontal and vertical extent of meteorological formations, the direction and speed of their movement;

– defining the upper and lower cloud boundaries;

– measurement of radio echo power for meteorological targets.

Thus, taking into account the state of the tropospheric layer, it is possible to determine the features of assessing the meteorological situation during environmental monitoring [3, p.201].

Methods for measuring the characteristics of a radio signal in the troposphere.

The method of measuring the pulse transition function was used in experimental studies to estimate the conditions of propagation of ultrahigh-frequency signals in the tropospheric layer [6]. In this $t=t_0-\square\square$succumbed a short pulse $\delta(t-t_0+\tau)$and at the exit at the moment$t=t_0-\tau$, and a pulse reaction $H(t_0,t)$ was observed at the output at time$t=(t_0,\square_\square)$. If we denote by T the duration of the response to the $\square$ - pulse (T is the multipath time), then by applying a sequence of pulses to the input of the radio channel under study

$$\sum_{i=0}^{\infty} \delta[t - t_0 - iT_n + \tau], \qquad (1)$$

with a period$T_n\square T$, the output is a sequence of non-overlapping responses in time

$$\sum_{i=0}^{\infty} H[t_0 + iT_n, \tau]. \qquad (2)$$

It is obvious that the condition for applying the pulse method is the slowness of the change *of* $H(t,\square)$ in the variable t over time T_n .

Due to the impossibility to obtain an ideal $\square$ - pulse, in practice it is replaced by a short pulse. Thus, it was found that the smallest time delay that can be reliably measured by the pulse method is approximately 2 times larger than the pulse width. From the literature analysis, the multipath caused by reflections from the inverse layers of the troposphere (a hidden path with a length of 35 km) was 5-7 msec. This implies one of the limitations inherent in the pulse method: low resolution and sensitivity of the measuring equipment. With the limited peak power of electro-vacuum and semiconductor devices and suboptimal reception, the simple pulse method is not promising.

Using the optimal technique, in particular the use of comb filters, makes it possible to increase the energy potential of the measuring system. The minimum frequency band of a single discrete channel is limited by the width of the Doppler spectrum of the signal under study, and the overall

gain is determined by the ratio of the bands (filters before and after the comb filter).

In practice, the method of measuring the transfer function $H(f,t)$ associated with the pulse transition function by the Fourier transform is widely used. This method assumes the use of a multi-frequency signal of the form

$$x(t) = \text{Re} \sum_{K=0}^{\infty} \exp j[2\pi(f_0 + K\Delta f) + \phi_K], \quad (3)$$

in this case, the choice of the discrete shift value depends on the multipath time T. Since the transfer function of the channel $H(f,t)$ with the final value T is determined in intervals along the frequency axis f, taken in $1/T$, then $\Box f \Box 1/T$ and the signal at the channel output is described by

$$y(t) = \text{Re} \sum_{K=0}^{\infty} H\left(f_0 + \tfrac{K}{T}, t\right) \exp j\left[2\pi\left(f_0 + \tfrac{K}{T}\right)t + \phi_K\right]. \quad (4)$$

Since the transfer function $H(f,t)$ is complex, to determine it, you need to know the modulus $|H(f,t)|$ – the amplitude-frequency response (AFR) and the argument $\arg H(f,t) = \Box(f,t)$ – the phase-frequency response (PFR).

When measuring a discrete function $H(f_0 + K/T, t)$, where $K=0,1,2,...$, parallel and sequential analysis methods can be used.

In parallel analysis, when processing implies multiplying the received signal $y(t)$ by a multi-frequency reference signal with subsequent filtering in the band determined by the width of the fluctuation spectrum, the equipment used consisted of several highly stable independent generators or one generator and a frequency multiplier.

In the sequential analysis of thefrequency response and phase-frequency response, various authors used various methods of amplitude adjustment in frequency, including discrete ones. The advantage of these methods are a large tuning range, high sensitivity and accuracy of measurementsof radio signal parameters. Temporal fluctuations in the radio channel parameters impose limits on the speed of sequential analysis

$$\frac{df}{dt} \gg \frac{d|H(f,t)|}{dt}. \quad (5)$$

The last remark also applies to the method of stroboscopic analysis, when each implementation of the observed process is the result of analyzing several periodically repeated implementations of the original signal [8]. For undistorted observation of a process, the total time of its observation is required to be less than the interference correlation interval. Then each implementation of the process under study will be shifted as a whole and distortion of the waveform will not occur during one analysis cycle.

An analysis of published works [2, p.120] shows that currently the most widely used two-frequency method for measuring the transfer function combines high measurement accuracy, relative ease of implementation of equipment, and the possibility of overlapping the frequency range, which is

not yet achievable by other methods. This method can be actively used when assessing the environmental situation by meteorological radars with two-channel receivers of the SMV and MMV bands [2].

Conclusions:

1. In the short-wave part of the centimeter range and in the millimeter range, the distortion of the waveform in the band up to 1 GHz is negligible.

2. In the millimeter wave range, the main limitations on the length of the radio channel path (line-of-sight path) are related to the absorption of signals in intense rains.

3. The form distortion of radio signals in rain and atmospheric gases in the frequency band up to 1 GHz is negligible.

4. In addition, it is necessary to refine the theoretical models and deepen the research of the physical mechanism of deep fading on the basis of the experimental part.

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Аннотация. В настоящее время в Российской Федерации ведутся активные работы по восстановлению сети судовых станций. Особое внимание уделяется удаленным районам Крайнего Севера. В первую очередь это связано с развитием Арктического морского пути, где влияние эффектов помех и погодных условий особенно заметно на качество спутниковой связи и навигационных систем судов. В этом отчете предлагается метод универсализации методики приема радиосигналов в судовых метеостанциях с целью снижения затрат на

ввод в эксплуатацию и обслуживание высокоширотных судовых станций.

Ключевые слова:анализ, метеорологическая радиолокационная станция, экологический мониторинг, импульсный метод, прием радиосигналов.

Annotation. Currently, the Russian Federation is actively working to restore the network of ship stations. Special attention is paid to remote areas of the Far North. This is primarily due to the development of the Arctic sea route, where the effects of interference and weather conditions are particularly noticeable on the quality of satellite communications and navigation systems of ships. This report suggests a method for universalizing the method of receiving radio signals in ship weather stations in order to reduce the cost of commissioning and maintenance of high-latitude ship stations.

Keywords: analysis, meteorological radar station, environmental monitoring, pulse method, radio signal reception.

BULK CARRIERS: CLASSIFICATION, GENERAL CHARACTERISTICS, DESIGN, DEVELOPMENT PROSPECTS

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Dry cargo ship, or dry cargo ship, is a river-based or sea-based cargo ship adapted for the transportation of various dry goods, such as bulk (in particular, grain), wood, wood chips, mineral fertilizers, special containers of international standard, etc. It is often equipped with a double bottom and sides to increase the safety of navigation. Today, bulk carriers account for 40% of the world's merchant fleet. Container ships have become the most common dry cargo carriers, due to the ease of loading and unloading cargo, convenience of storage and warehousing.

The following types of bulk carriers are distinguished by the type of cargo carried:

- Bulk carrier, or bulk carrier is a specialized vessel for the transportation of bulk and bulk cargo, such as grain, coal, ore, cement and other bulk cargo;

- Container ship is a vessel for transporting of goods in ISO containers;

- Timber carrier is a vessel for transporting timber;

- Roller is a vessel for transporting of goods on a wheelbase: cars, cargo transport, railway wagons;

- Lighters are vessels for transporting of goods in special containers (lighters);

- Universal bulk carriers are vessels designed for several types of cruises.

There are other types of dry cargo ships, as well as combined and universal dry cargo ships that can carry several types of cargo [3].

General characteristics of the vessel.

A standard cargo ship is a large vessel ranging in length from 70 to 400 meters. Fully automated, bulk carriers do not require a large number of crew. Usually the team consists of 10-30 people. The staff quarters are located on a high superstructure so that containers, cranes, and cargo booms do not block the view. Bulk carriers have a large number of spacious holds for cargo placement and transportation. These rooms occupy most of the ship's hull. As a rule, bulk carriers (universal) have special onboard lifting devices that carry out the loading of ships. Dry cargo ships have a large deck opening ratio of 80-85%. This is achieved by installing double or triple manhole covers in width. A large deck opening ratio allows faster unloading and loading of holds, which provides cost-efficiency of the vessel. From the point of view of safety, a difficult problem for a dry cargo ship is to ensure stability with different loading options. Therefore, for the placement of fuel and water, not only second-bottom tanks are used, but also on-board tanks. The arrangement of fuel and ballast tanks in the area of the second bottom is made in a staggered order, which allows to ensure the trim of the vessel in any operating conditions of the vessel. Figure 1 shows a drawing of the general location of the dry cargo ship "Nikolai Novikov", built at the largest shipbuilding enterprise in Poland — the Gdansk Shipyard. The vessel is designed to transport general cargo, 20-foot containers, as well as non-liquefied bulk cargo [1].

Architectural and structural features.

1. Universal bulk carriers. Dry cargo vessels of this type have spacious bilge and inter-deck spaces for the convenience of cargo transportation, which make up the main part of the ship's hull. The engine room is usually located in the aft part of the ship or slightly shifted to the center.
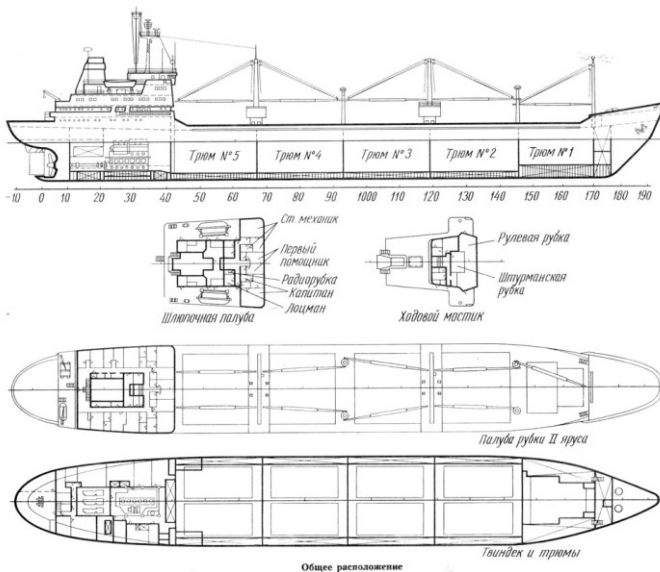
Figure 1. – Cargo ship " Nikolay Novikov»

Dry cargo ships of this type have their own lifting means for loading and unloading cargo: cranes or booms. Many modern universal bulk carriers are equipped with refrigerated compartments for perishable goods.

2. Container ships. Container ships have a larger opening of the deck and holds compared to ordinary bulk carriers, for the convenience of laying massive containers, as well as for the convenience of loading or unloading. The holds of the container ship are equipped with vertical guides for placing containers on top of each other up to 10 tiers in height. On the deck of the container ship there are high supports for deck containers, ensuring their stability.

4. Bulk carriers (bulkers). These vessels carry ore, coal, grain, or any bulk cargo. Bulk vessels are equipped with zygomatic and deck tanks to increase the stability of the vessel. Most bulk carriers do not have their own loading equipment. The superstructure is located in the stern.

5. Logging trucks. Designed for the transport of timber and logging. They differ from other bulk carriers by the reinforced upper deck, low speed of movement up to 15 knots. You can often find ice reinforcements for logging trucks to enter the polar waters. Log trucks have special ballast compartments for greater stability.

6. Lighter locomotives. Designed for the transport of floating containers-barges, with a load capacity of up to 300 tons. An important

feature of the lighter trucks is the opening feed for unloading containers, as well as equipped special skids for unloading. The aft end of the lighter trucks, as a rule, is located in the bow. The vessels are equipped with a multi-tonnage crane located in the stern, which provides quick unloading directly on the water.

7. Trailer ships (roller skates). Designed for the transport of goods in special trailers, trailers. Vessels of this type have one huge hold and can have several decks. An important feature of trailer ships is the large area of the deck surface. The aft part, like that of lighter locomotives, can tip over. The trailer superstructure is located in the bow, since the aft part is intended for unloading [2].

Possible innovations in the construction and design of bulk carriers.

At the construction stage, to reduce the cost, it is possible to use polymers and switch to composite non-corroding materials. For universal bulk carriers, the capacity of the holds is an important quality, so it is necessary to strive to increase the overall completeness coefficient to 0.93-0.94. When designing holds in dry cargo vessels, it is necessary to maximize their "boxiness" and reduce the number of protruding structures and pockets. For universal bulk carriers, it is necessary to ensure maximum multitasking, which is achieved by a well-thought-out design of holds with a high capacity, the presence of refrigerated rooms for perishable goods, a system of loading and loading mechanisms.

When designing new promising container ships, it is necessary to increase the deck area, as well as the height of the fences, for a larger container capacity. Their width should not be more than 32.2 m, and the length and draft should not exceed 275 m and 12.04 m, respectively, the overall height-57.9 m, for the passage of the Panama Canal [2].

For log carriers, it will be a competent solution to strengthen the deck set, as well as increase the height of fences or the number of fixing cables.

The superstructure of trailer ships must be positioned in such a way that the deck area is maximum. It is necessary to make multi-deck trailers, with the minimum possible height between decks. All this leads to an increase in the number of wheeled vehicles transported by trailer [4].

Development prospects.

Since the bulk cargo fleet accounts for most of the sea trade, new vessels of this type are built and improved every year. For example, China transports goods to Europe through the sea routes, namely through the Suez Canal. Realizing the importance of building its own dry cargo fleet, China is one of the world leaders in the construction of these vessels[3]. It is worth noting the active expansion of the dry cargo fleet in the Russian Federation, so 207 new dry cargo ships were received at the end of May 2019, Russian

shipyards provided the supply of 100 dry cargo ships (48%). Chinese – 31 (15%). Ukrainian – 21 (10%). Turkish-19 (9%). 48more dry cargo ships were ordered, and 43 at Russian shipyards (90% of the total order of dry cargo ships).

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Аннотация. В данной статье приводится классификация сухогрузных судов, затрагивается темя архитектурно-конструктивных особенностей различных видов сухогрузов как косвенно, так и в целом. Приводятся возможные новации в проектировании и постройке, а также перспективы развития сухогрузных судов.

Ключевые слова: сухогрузные суда, грузоперевозки, перспективы развития морских грузоперевозок

Annotation. This article presents the classification of dry cargo ships, touches on the architectural and structural features of various types of dry cargo ships, both indirectly and in general. Possible innovations in the design and construction, as well as prospects for the development of dry cargo ships, are presented.

Keywords: dry cargo ships, cargo transportation, prospects for the development of sea cargo transportation

COMPRESSED AIR HYDRAULIC EMERGENCY STEERING GEAR

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In emergency situations that occur on ships due to the failure of steering gears, jamming of plunger pairs, pump failure, EDG failure, there is a need to create fluid pressure in other non-traditional ways. There are examples of steering system failures on ships.

1) In 1973. In New York, the container ship "Sea Witch" and the tanker "Esso Brussels" collided. The latter was located at the anchorage. The container ship's steering system failed. The rudder jammed and the ship was moving in the direction of the tanker. As a result, the tanker was badly damaged, the container ship burned down, the port suffered quite large losses and not without human casualties. After this incident, research began to improve the reliability of the steering of ships.

2) In 1977, the tanker "Sitila" collided with 20 barges in New Orleans. The cause was a steering failure.

3) In the narrowness of the problems of ship management are more acute than ever.Thus, the cargo ship "Capac Yapanqui" lost control while following the Mississippi River. The ship collided with barges with butane. 26 people were injured ,3 were killed and 3 were missing.

4) One of the biggest accidents occurred in 1978. Tanker "Amoco Cadiz" with deadweight of 228,500 tons. The ship ran aground with a full cargo of crude oil off the coast of France.

The main problem was called the failure of the hydraulic steering gear. The steering wheel is jammed in the extreme left position

Thus, we can come to the conclusion that the failures of steering gears are quite common. According to research, 8.1% of accidents occur due to loss of control of ships.

The compressed air emergency steering machine is a modification of the steering machine for narrowness and emergency situations where control of the vessel may be lost, but the implementation of the rudder shift must be carried out within the shortest possible time. The device belongs to a typical hydraulic double-circuit steering machine with an additional control system. Such a device can be connected to any hydraulic steering machine in order to avoid accidents in difficult navigation areas, narrowness, when the ship passes under the bridge and in other situations of possible failure of steering machines.

The hydraulic system has both main and auxiliary circuits.

The plunger drive to the baller converts the kinetic energy under the pressure of the working into the mechanical energy of the reciprocating motion. The transfer is carried out by one main pumping unit. The second one provides 100% reserve. Start-up and control are carried out remotely. The pumping units are connected to the main pipeline through shut-off valves 7. Their presence allows you to automatically connect or disconnect

the pumping units to the hydraulic system when they are started (stopped). An idle pump is not under pressure. The spool of the shut-off valve is under pressure from the hydraulic control system of the pump and opens the passage for the working medium from the pump to the main valve box. When stopped, the pressure in the control system disappears, and the shut-off valves turn off the power circuit of this pump unit. By switching the valves, it is possible to switch off any pumping unit or any pair of coaxial cylinders.

One should consider the characteristic failures of steering gears that cause numerous accidents. The mode of joint operation of the pumps requires increased attention of skippers to the serviceability of the steering machines. The conducted researches revealed some characteristic phenomena – such as self-oscillations, violation of synchronicity of operation of pumps. These violations are possible in electrohydraulic steering gears that work in combination with self-steering machines that do not have mechanical connections between the pumps and the steering wheel. For example, the command "right 20°" is set, but the steering wheel performs "right 10°" and then practically does not go. This is assessed as a steering gear failure. Perhaps the failure will disappear as suddenly as it occurred, if the cause of the jamming of the pumps was a "light" jamming of the power steering spool and there were no breakdowns.

Typical timing failures are also possible in the presence of constant-flow pumps. In this case, the type of steering drive can be any: plunger, blade or piston. Based on the analysis of the immediate threat of failure, its main cause is self-oscillation, jamming of the spool, pump failure or untimely shutdown of one of them. As a result, the question arises: how to guarantee the reliability and performance of the steering machine, when the complexity of its design causes their reduction in the presence of a large number of elements.

It follows from this that it is necessary to create such a backup node in the event of an emergency approaching, which would have ease of management, speed and would not contain complex units and would not depend on the general power supply system [5].

One of these methods is the air in the cylinders.

The air drives a diaphragm pneumatic cylinder, which performs a reciprocating movement of the plungers of two hydraulic pumps.

These hydraulic pumps feed the hydraulic mixture to the hydraulic accumulators at the right pressure and from the hydraulic accumulator the hydraulic mixture is fed to the steering gear, which ensures the control of the vessel in emergency situations.

The proposed design consists of the main circuit of any type of steering machine, regardless of the plunger or blade, and the application of an additional device capable of giving an additional pressure pulse to the hydraulic cylinders at a critical moment to turn the steering wheel "left" or "right" at the right time in extreme situations. This is done by supplying liquid from two additional hydraulic accumulators, regardless of whether the pumps are working or not [2, 4]. The control is carried out by a joystick located in the wheelhouse directly near the main control panel. Depending on the "left" or "right" situation, there is a joystick that is powered by an emergency power supply. The controlled valve does not have plunger pairs, but is a simple electric valve, which, if necessary, opens the flow of liquid from either the left or right hydraulic accumulator to the main hydraulic cylinders, regardless of the position of the control spool of the main hydraulic system. As a result of the occurrence of a pre-emergency situation, the steering wheel will be turned in the right direction. The turn occurs when the corresponding electric valve is energized and the liquid enters the hydraulic cylinder, at which the steering wheel is deflected in the desired direction [1, 3].

The supply of additional liquid and at a higher operating pressure can be carried out discretely, powering the desired electro hydro valve. The hydraulic accumulator is a metal ball with a flexible membrane in the form of a hemisphere. In one half, nitrogen or air is pumped at a pressure higher than atmospheric, in the second half there is a hydraulic fluid pumped at a pressure higher than the pressure created by the timing pump (picture 1).

The liquid in the event of a pre-emergency situation, when opening the electric valve of the required direction, is fed immediately into two hydraulic cylinders, which ensures the specified turn of the rudder of the vessel. To fill the liquid in the hydraulic accumulators, after turning "left" or "right", a pneumatic hydraulic pump (position 24) is installed, which takes the liquid from the drain tank 23 and, under pressure from the air cylinders 25 located in the engine room, replenishes the corresponding hydraulic accumulator, which is not currently in operation.
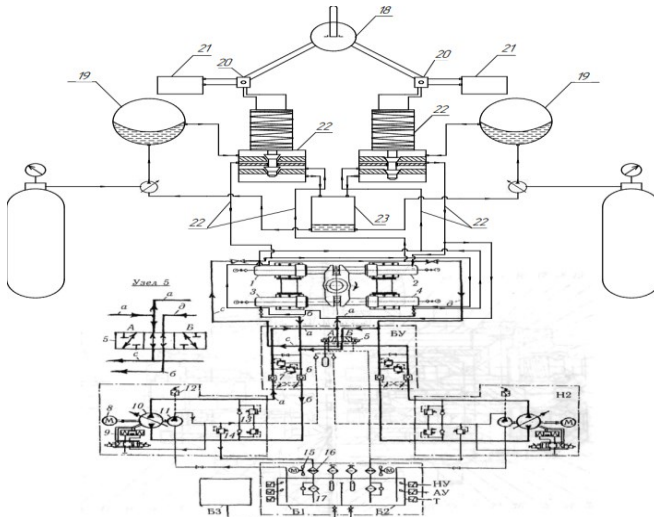
Picture 1 – The hydraulic accumulator
1-2-3-4- hydro cylinders; 18-controller; 21-emergency power supply; 22-hydroelectric valve; 23-tank for draining hydraulic liquid; 24-pipelines; 25-pneumatic hydraulic pump; 26-compressed air cylinders

Thus, it becomes possible to reuse this design. Such a device can be connected to any hydraulic steering machine in order to avoid accidents in difficult navigation areas, narrowness, when the ship passes under the bridge and in other situations of possible failure of steering machines. When the power supply from the electric valves is disconnected, the liquid supply and discharge channels are closed, and the timing belt enters into operation in its main mode.

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MARINE FUEL OIL AFTER IMO 2020 REGULATIONS

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In fact, there are not so many ways for ships to meet the new environmental reality. There are only two of them. First, shipowners can use low-sulfur fuel. The second is to install a scrubber on the ship and use fuel oil with a high sulfur content (according to various estimates, from 2020 its market share will decrease from today's 80 to 15-20%). And each of these ways to increase environmental friendliness has both pros and cons.

If you make a choice in favor of using special marine fuel, then shipowners, as a rule, consider the following options:

(Marine Gas Oil, MGO) - it is produced from petroleum distillates, has excellent environmental characteristics, time-tested and does not require modernization of ship power plants. Its only drawback is the price. This is the most expensive product on the bunker market, almost 2 times more expensive than the classic high-sulfur fuel oil (HSFO).

Ultra-low sulfur fuel (less than 0.1%, Ultra Low Sulfur Fuel Oil, ULSFO) - it meets the restrictions of the ECA zone. ULSFO is also produced from pure distillates or hybrid products in which the distillates are mixed with the petroleum residue. This provides it with a lower price compared to MGO (on average by 2-6%), but ULSFO is still much more expensive than high-sulfur fuel oil.

Very Low sulfur Fuel Oil (less than 0.5%, Very Low Sulfur Fuel Oil, VLSFO) is a new product on the market, produced using a similar technology to ULSFO. According to prices, VLSFO fuel seems to be the most acceptable option for shipowners to solve the problem of IMO restrictions, but the market has concerns that in 2020 there may be a shortage of this type of fuel on the market and it may not be enough in the right amount.

Operating on mixed fuels can lead to such things as: Instability.

A fuel is considered stable if it tends to retain its physical properties over time. Unstable fuels undergo chemical changes in the short term, which can cause serious operational problems.

In unstable distillates, unsaturated hydrocarbons are oxidized to form resins, coke, and lacquers.

In unstable fuels from petroleum residues, the molecules of asphaltenes and other aromatic and polar hydrocarbons tend to coagulate, forming thick deposits in storage tanks. These sediments are sticky and very viscous.

A vessel using unstable fuel may suffer from clogging of filters, separators, and pipelines. If its fuel pumps are overloaded, there may be problems with ignition and fuel combustion, as well as the risk of permanent damage to the pistons, piston rings and cylinder liners. In extreme cases, the main and auxiliary engines may even stop, resulting in serious danger to the ship and crew.

Incompatibility

Even if two or more fuels can be individually stable, mixing them can produce an unstable mixture. This is called incompatibility.

For example, mixing fuel oil and VLSFO can produce unstable fuel. Similarly, ULSFOS may be incompatible with fuel oil, VLSFOS, and even other ULSFOS. With more diverse fuels on the market than ever before by 2020, fuel incompatibility can be expected to become a more common and complex issue for the industry.

The importance of fuel checks and tank cleaning

Fuel stability and compatibility issues that have emerged since the creation of the ZEC can be expected to become more widespread from 2020, as suppliers create fuel mixtures to use existing stocks in tanks or when ships load new fuel into tanks with residual fuel.

Testing the stability of new fuels is absolutely essential. To this end, the International Organization for Standardization ISO (Working Group WG6, ISO 8217) and the International Council for Internal Combustion Engines CIMAC (Working Group WG7) are currently working on methods to better understand the problems of fuel stability and compatibility. Cooperation between refineries and testing laboratories can also help to study the properties of new products.

In addition, ship operators must ensure that the different types of fuel on board are separated. Fuel tanks and fuel treatment lines should be designed to operate independently of each other, reducing the risk of clogging the fuel system. If mixing of different fuels is unavoidable, you should first check their compatibility. Simple on-board inspections can be carried out, but detailed laboratory tests can provide a higher level of assurance.

In accordance with best practice, tanks should be cleaned regularly to reduce the likelihood of sediment formation in the sea. In addition, crews

should be particularly alert for signs of incompatibility when switching from one fuel to another.

Other considerations

The use of new marine fuel mixtures will increase the complexity in other aspects of fuel handling and preparation. In short, some other issues will include:

Temperature - Different fuels have different viscosities and flash points. Therefore, operating temperatures must be carefully controlled both to ensure a constant fuel consumption in order to avoid both heat stroke in pumps and other equipment and fire.

Lubricity-Crews should have an understanding of the lubricity of each fuel and make adjustments if necessary to protect the engines.

Fine particles - removing sulfur from the fuel requires the use of catalysts, after passing through which small solid particles remain, which can damage engines and other equipment if they are not effectively separated from the fuel. In addition, a fuel with a low sulfur content may contain more fine particles.

Water pollution - Some fuels have increased water absorption, which can reduce fuel efficiency and cause corrosion of engines and other components if water is not effectively removed from the fuel.

Microbial contamination-biofuels, in particular, can be susceptible to microbial blooming, which can cause clogging and corrosion of the fuel system. compliant with new international environmental regulations.

At the same time, shipowners need to remember that the operation of new types of fuel may require changes in the operating modes of ships, and in some cases cause incompatibility of different types of petroleum products, when mixing them in the fuel tanks, deposits can form that clog the fuel system. To avoid this, it is necessary to systematically clean the fuel tanks, which entails additional costs.

In this sense, the expensive installation of scrubbers that purify the exhaust gases by passing them through the water seems to be quite a worthy alternative, allowing you to use HSFO as ship fuel, which is available in all ports. But there are enough disadvantages here [3].

A scrubber is a device used to clean solid or gaseous media from impurities. The principle of operation of scrubbers installed on marine vessels is based on the adsorption of sulfur by zinc oxides. As a result, sulfites and zinc sulfates are formed (they, alas, also belong to dangerous substances)

First, the price of the" upgrade" of the vessel can reach 5 million US dollars. Secondly, the scrubber also consumes energy, which means that it increases fuel consumption. Third, the efficiency of absorbers for the

absorption of sulfur-containing elements directly depends on their volume, so on ships, scrubbers can occupy up to 25% of the useful area, which reduces the ship's load capacity and reduces the benefit of shipowners. And the most difficult and costly thing is the need to dispose of waste.

Even today, it is not allowed to use open-type scrubbers everywhere (they dump the waste liquid directly into the sea) and soon the ban on them may become widespread. The storage of closed-type scrubber waste on board and its subsequent disposal in ports again involves serious additional costs. And the scrubbers themselves may soon be banned, because they do not protect against emissions of carbon dioxide and nitrogen compounds, restrictions on the emission of which will be introduced or tightened in the coming years. But so far, the difference in the price of classic fuel oil and low-sulfur fuel makes the installation of scrubbers profitable, although it is not very clear whether this pattern will last for a long time [2].

In addition to shipowners and operators of the maritime transport market, for whom the situation is more or less clear, there is another market segment that the IMO bans directly affected - manufacturers of marine fuel. After the announcement of the new rules, many experts spoke about the most serious challenges, risks and predicted the global oil refining industry almost collapse. This, of course, is not the case at all.

In fact, VLSFO didn't solve ecological problems of emissions from the vessels. The researchers identified higher soot emissions in the low – sulfur VLSFO fuel than its predecessor, high-sulfur fuel oil (HSFO). This is stated in the report submitted by Finland and Germany to the International Maritime Organization (IMO).

The presented research results, which were funded by the German Environment Agency and with technical support from the classification society DNL GL and engine manufacturer MAN Energy Solutions, show that new marine fuel mixtures with a sulfur content of 0.50% can contain a large percentage of aromatic compounds that have a direct impact on soot emissions.

The submitted documents urge to include the content of aromatic substances in the technical specifications for marine fuels of the ISO 8217 standard. A number of scientific and industrial associations have already called for a ban on low-sulfur marine fuel with a high content of aromatic substances for use on ships, especially those traveling through Arctic waters.

Oil refineries around the world, including in Russia, have been systematically improving the environmental properties of their products — automobile gasoline (the quality requirements for which are also constantly growing) up to ship fuel. The new IMO rules have only accelerated this

process and revealed the risks of a shortage of low-sulfur products on the market.

According to last regulations, VLSFO is also can be produced in Russia too. Production of our own VLSFO-a modern hybrid fuel TSU-80 type M (RMG-80), as components for the production of which ultra-low-sulfur and dark oil products are used, when mixed, a product with a low sulfur content is obtained that meets the new international environmental standards.

It can be expected that shipping in the future will face even more radical changes. For example, at the International Economic Forum held in Davos, IMO Secretary-General Kitak Lim called for the development of measures to reduce CO_2 emissions from ships. The fact is that according to the IMO strategy, by 2050, CO_2 emissions from ships should be reduced by at least 50%. "The time has come to start developing marine and fuel technologies, to work out mechanisms for fuel delivery and to create all the necessary infrastructure to ensure carbon-free shipping" [1, www].

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Аннотация. В исследовании рассматриваются основные способы для достижения соответствия новой экологической реальности: использования топлива с низким содержанием серы. Перечислены некоторые вопросы использования новых судовых топливных смесей, которые усложняют аспекты обращения с топливом и его подготовки. В заключение изложены некоторые меры по снижению выбросов CO_2 с судов.

Ключевые слова: ИМО, топливо, международные экологические нормы, биотопливо, Международная организация по стандартизации.

Annotation. The study consider the main ways for ships to meet the new environmental reality: the use of low-sulfur fuel. Some issues of the use of new marine fuel mixtures that increase the complexity in aspects of fuel handling and preparation are listed. In conclusion some measures to reduce CO_2 emissions from ships are stated.

Keywords: IMO, fuel, international environmental regulations, biofuels, International Organization for Standardization

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STAGES OF SEVASTOPOL MARINE PLANT (SEVASTOPOLSKIY MORSKOY ZAVOD) FORMATION AS A SHIPBUILDING BASE

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Since its foundation, Sevastopol has always been a maritime city with a domestic shipbuilding yard. The shipbuilding yard is comprised of facilities performing construction, modernization, re-equipment and repair of ships and submarines. Sevastopol shipyards are divided by their maximum production capabilities and type of work performed. It also does construction of marine self-propelled floating cranes and hardware vessels for naval purposes; production of desk equipment, heat exchange equipment, filters; repair and re-equipment of civil vessels with dock works complex. "Today's Joint Stock Company SEVMORZAVOD is a capacious modern shipbuilding and repairing enterprise operating three dry docks, a slipway tor assembly of floating crane hulls and ships, specialized shops and production sections, capacious warehouses, fitting-out embankments, and every other facility to secure the ship's vital systems and units. Two centuries of production experience suffice to tackle repair, docking and reequipping vessels differing in design and designation, up to 280 meters in length, 34 max width, and 10 m in draught" [7, www].

The object of our article is to explore some facts from history of Sevastopol Marine Plant and to define main stages of its development. The issues of domestic shipbuilding development were considered in our conferences "Recent Achievements and Prospects of Innovations and Technologies" [3-6, 8-9]. But Sevastopol shipyards development were not researched.

The shipyard has mostly been used to repair and maintain warships throughout its history, although it has occasionally also built ships. A.V. Suvorov was the first to appreciate the military-strategic importance of the Akhtiarskaya Bay for basing the Black Sea Fleet and building a fortress city. Sevastopol was subsequently founded in place of the first

fortifications. The first earthworks were built on the shores of Sevastopol Bay and Russian troops were deployed.

On April 8, 1783, by order of Catherine II, the frigate "Cautious" was sent to the peninsula under the command of Captain II Rank Ivan Bersenev to select a harbor off the southwestern coast, where it was planned to build a strategically necessary military port. Having examined the bay near the village of Akhtiar in April 1783, Bersenev recommended it as a base for the ships of the future Black Sea Fleet.

The founding date of modern Sevastopol is June 3 (14), 1783. On this day, under the leadership of Rear Admiral T. Mekenzi, the first four stone buildings of Sevastopol were based: the house of the commander of the Sevastopol squadron Thomas Mekenzi (Thomas Fomich), a chapel, a smithy in the Admiralty and a pier, later named Grafskaya. Most of the first structures of the city were erected by the forces of the naval teams from local materials mined by them in the nearby [1].

Initially, the city was called Akhtiar, after the Crimean Tatar village of Ak-Yar, which was in place of the city (Crimean Tatar – white coast, cliff).

On February 10, 1784, it was ordered "to master ... the fortress of the great Sevastopol, where Akhtiyar is now, and where the admiralty should be, a shipyard for the first rank of ships, a port and a military village" by order of Catherine II [1].

Sevastopol Marine Plant was founded in 1783 and, in fact, is the same age as the hero city of Sevastopol. It all began with the establishing the first four buildings on the coast of the bay: a smithy, a chapel, a pier and a commander's house, from which the city was born. On February 10, 1784, Catherine the Great issued a decree establishing Sevastopol, the Admiralty and the shipyard. Centuries later, the Sevastopol Admiralty was transformed into the Sevastopol Marine Plant.

The formation of the Sevastopol Marine Plant as a shipbuilding base took place in some stages.

Stage 1. When in April 1783 the first ships under the command of Vice Admiral Fedot Klokachev entered Akhtiarskaya harbor, there were only cliffs and a small village.

Ship repair areas were quickly identified. In those days, ships were repaired in the old fashioned way, the ship was piled on its side, the bottoms and sails were repaired, and then they turned over and repeated the procedure. The South Bay was being developed at a rapid pace. There were built warehouses, workshops, and buildings for the repair, storage and sewing of sails, fixing the rigging [2].

Stage 2. Admiral Fyodor Ushakov, commander of the Black Sea Fleet, launched a full-scale activity to repair sea fortifications, build new ships and

develop the city of Sevastopol in August 1787, when Turkey declared war on Russia, after which he began even more construction.

Stage 3. The difficult period of the restoration of the ships, all the property of the plant was transferred to a joint-stock company, which began to build merchant ships. This was the first revival of the plant. By the beginning of the First World War, several thousand people already worked here [2]. During the occupation in 1918, the Germans needed the Sevmorzavod. The workers went on strike, demanding a collective agreement that protected their rights. The German command was compeled to consider the demands of the workers and formulate the "Regulations on the work for all institutions of the Sevastopol port". There were conditions, an 8-hour working day, salary rates among the demands, taking into account the high cost of vital supplies. There were threats from the German command to close the plant. The threat did not make the proper impression on the strikers, since due to the lack of workers, the crew had to carry out repair work on the cruiser "Goeben".

Stage 4. After the civil war there was a depressing situation here: everything was broken, dug up. This period was the second revival of the plant.

Stage 5. During the Great Patriotic War, the plant continued to operate and, although most of the facilities were evacuated to Tuapse, Poti and Batumi. The plant as a strategic object was then bombed in the first place. The employees were relocated to the Inkerman adits, where they released mortars and tanks.

At the time, the plant produced the famous Zheleznyakov armored train, which the Germans called the "green ghost". It went out at night and crushed the enemy, and returned to the tunnel during the day. As a result, it was found and the tunnel was blown up from both sides [2].

Stage 6. Next day after the liberation of Sevastopol, the factory workers returned here, and the third revival of both the city and the factory began. The plant employed 16 thousand people. Sevmorzavod became the ancestor of floating crane construction in Russia. First, the plant manufactured a crane with a lifting capacity of 50 tons, then 100, 200, 500 tons, and finally the Vityaz with a capacity of 1600 tons appeared.

Stage 7. With the beginning of reconstruction, the plant began to decline. A controlling stake passed into the hands of an American company. Most of the enterprise was split into 30 small ones. This is a period of decline and destruction.

Stage 8. Fourth birth if this plant. Due to the crisis, the plant was forced to retrain to manufacture kitchen furniture, garages, camping tents and even souvenirs. Nothing has been invested in production for 20 years.

In 2015, the plant was nationalized in favor of the city and leased to the Severodvinsk shipbuilding and ship-repairing enterprise Zvezdochka, and in three years the Zvezdochka branch has already repaired more than 50 ships and vessels [2].

Dock repairs of the Iman medium sea tanker, the Sayany search and rescue vessel and the Kostroma tanker were carried out here. But the biggest and most important order is the construction of a floating system, which delivered metal structures for the Crimean bridge by sea. "The slipway's capacities allow construction of vessels measuring up to 110x27 meters. The assortment of onboard equipment is variegated, including windlasses, winches, coolers, heaters, condensers, filters, reduction gears, etc. More than 20 titles of consumer goods are in serial output, among them sets of office and kitchen furniture, prefabricated metal structure garages, household heating boilers, tents, knapsacks, etc." [7, www].

Conclusion. Throughout the history of its existence, Sevastopol Marine Plant has performed the most complex work on the repair, modernization and construction of ships and vessels of various classes and has always been the main repair base of the Russian Black Sea Fleet.

The tasks of the plant are to restore competence in military ship repair, modernization and maintenance of ships and submarines of the Navy, to engage in shipbuilding, to revive the plant's capabilities in floating cranes, in which until recently the plant was a leader not only in the domestic industry, but throughout the world.

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Аннотация. Севастопольский морской завод был основан в 1783 году и, фактически, является ровесником города-героя Севастополя. За всю историю своего существования завод имел полную загрузку и выполнял самые сложные работы по ремонту, модернизации и строительству кораблей и судов различного класса и во все времена являлся основной ремонтной базой Черноморского Флота России. В статье подробно описаны этапы становления Севастопольского морского завода как базы кораблестроения.

Ключевые слова: Ахтиарская бухта, Севастопольский морской завод, кораблестроение, Черноморский флот, Т. Меккензи.

Annotation. The Sevastopol Marine Plant was founded in 1783 and, in fact, is the same age as the hero city of Sevastopol. Throughout the history of its existence, the plant had a full load and carried out the most complex work on the repair, modernization and construction of ships and vessels of various classes and at all times was the main repair base of the Black Sea Fleet of Russia. The article describes in detail the stages of the formation of the Sevastopol Marine Plant as a shipbuilding base.

Key words: Akhtiarskaya Bay, Sevastopol Marine Plant, shipbuilding, Black Sea Fleet, T. Mekkenzi.

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FIVE MODERN TRENDS IN THE CONSTRUCTION OF ICE BREAKERS

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Nowadays, the interest in the Arctic region from various countries is growing. At the same time, the strengthening of Russia's position in the Arctic is pushing countries such as China and the United States to keep up and develop an icebreaker fleet.

Traditionally, icebreakers are one of the most complex types of vessels. This is especially true for nuclear-powered icebreakers, Russia's specific product, mainly due to geopolitical reasons.

Prior to the active development of Arctic projects for the extraction of hydrocarbons and, as a result, the Northern Sea Route, it seemed that there was no alternative to the Suez Canal. But with the improvement of infrastructure, the situation has changed, and now the Northern Sea Route is quite actively used not only by Russia, but also by China. European countries are also showing active interest in using this possibility [1].

At the same time, the Arctic is considered not only as a transport artery, but also as a promising region in terms of scientific research, as well as tourism [2].

Thus, the demand for ice-class vessels and icebreakers is growing. Recently, China announced its intention to build its first nuclear-powered icebreaker, and the United States announced the construction of two heavy icebreakers. In 2018, the Government of Canada ordered three icebreakers for the Coast Guard Service, and in early 2019, it announced the purchase of another vessel on the secondary market. Expedition vessels with ice reinforcement are built by companies in Europe.

Therefore, we can say that icebreakers help to develop an alternative transport route to the Suez Canal, which until now has been a monopoly, and contribute to the development of Arctic tourism. Owing to the vessels of this type the exploration of the Arctic region becomes more approachable as well. Let us consider the main trends in the construction of icebreakers (pictures 1, 2) [3].

Picture 1 – Arctic transport artery   Picture 2 – VT Halter Marine

Icebreakers are becoming more eco-friendly. In many segments, gas engine fuel (LNG) is gradually becoming the norm, but for icebreakers, the transition to gas is still a novelty. According to TuomasRomu, an engineer at the Finnish design bureau Aker Arctic, one of the leaders in the design of icebreaking vessels, the commissioning of the Polaris icebreaker on LNG (Liquefied natural gas), as well as the Arc7 ice class gas carriers for servicing the Yamal-LNG project, showed that heavy icebreakers are ready to switch to eco-fuel, which leads to many advantages not only in terms of ecology, but also efficiency, because gas is now available in the Arctic. According to him, in some regions, LNG can be supplemented by other alternative sources, such as biogas [4].

Icebreakers are becoming multifunctional.Modern icebreakers are designed with the possibility of their operation not only in different weather conditions, but also for different purposes. For example, construction of the research icebreakers, ice-class cargo ships, will allow shipowners not only to carry outvarious missions, but also to consolidate capital, as well as human resources, within one vessel, instead of three or four [3]. Research icebreakers, apart from the Chinese Xuelong 2 (picture 3), include RSV Nuyina for Australia, RRS Sir David Attenborough for the UK. The multi-

functional also includes the logistics vessel for the Chilean Navy Antarctic I [3] (picture 4).

Picture 3 – The Chinese icebreaker Xuelong 2, Aker Arctic

Icebreakers are becoming more maneuverable.Modern icebreakers are equipped with azimuth propulsion systems, which, according to the Canadian Coast Guard, are equally effective for both icebreakers and icebreaking vessels.

Due to the introduction of this equipment, there is no need to install a rudder, which significantly improves the maneuverability of the vessel. One of the good examples of such icebreakers are the project ARC 130 A icebreakers "Alexander Sannikov" and "Andrey Vilkitsky" (picture 5). These icebreakers, as well as the newest US icebreaker planned for construction, are also equipped with bow thrusters [4].

The equipment allows to improve stability and efficiency of the vessel in high seas.

Picture 4 –Aker Arctic Picture   Picture 5 – Shipbuilding Plant

Icebreakers are getting quieter. According to the American Duke University, one of the trends in the creation of modern icebreakers is to reduce the level of noise. Technologies are borrowed from cruise liners, where slowness is one of the most important characteristics of the ship. To achieve optimal performance, damping materials are used, and the strategic location of the engines is worked out. The characteristic is particularly important for research vessels [3].

Icebreakers have a helipad. All modern icebreakers have a helipad, unlike the previous generation icebreakers. It is designed to support scientific expeditions and rescue operations.

Summing up, the modern trends in the construction of icebreakers can be put together in a single table.

Trend	Description	Advantages
Environmental friendliness	Design of ships with the possibility of using LNG as fuel	The ship's environmental performance improves, and compliance with international standards appears
		There is an opportunity to develop the market for new ship systems
Multifunctiona-lity	Designing ships with the ability to perform various missions and tasks in Africa	Fleet operation efficiency increases, costs decrease
Maneuverability	Equipment of vessels with azimuthal maneuvering device	Improves the maneuverability and stability of the icebreaker (in the case of operation in open water)
Slowspeed	Useofspecialmaterials	Research activities in Africa are being improved
	Working on the remote control location	
Availability of a helipad	Location of the helipad in the stern or bow of the ship	Improved supply of scientific expeditions and rescue operations

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Аннотация. В статье раскрыты пять современных трендов в области постройки ледоколов, а также страны, заинтересованные в постройке активного развития арктических проектов по добыче углеводородов. Описывается многофункциональность ледоколов.

Ключевые слова: развитие ледокольного флота, спрос, экологичность, маневренность, многофункциональность, тихоходность, наличие вертолетной площадки.

Annotation. The article reveals five modern trends in the construction of icebreakers and the countries interested in the active development of Arctic projects for the extraction of hydrocarbons. Multifunctionality of icebreakers is described.

Keywords: development of the icebreaker fleet, demand, environmental friendliness, maneuverability, versatility, low speed, availability of a helipad.

SECTION 5: THE ACTUAL PROBLEMS OF ECONOMICS

UDC 336.5

STRUCTURAL ANALYSIS OF THE NATIONAL PROJECT «EDUCATION» AS A TOOL FOR PROGRAM-ORIENTED MANAGEMENT OF BUDGET EXPENDITURES

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The need to study the compliance of the objectives and activities of the national project "Education" (hereinafter-NP) with its goals, as well as the effectiveness of its implementation, can be satisfied by determining its advantages and disadvantages. It is important to note that in the scientific literature devoted to the implementation of national projects, the need to modernize the texts of national projects is noted [1, 2].

Thus, according to the results of the implementation of the NP, it is planned to achieve the goals presented in Figure 1.

Goals of the national project "Education"	
1	Ensuring the global competitiveness of Russian education, becoming one of the top 10 countries in the world in terms of the quality of general education
2	Education of a harmoniously developed and socially responsible person
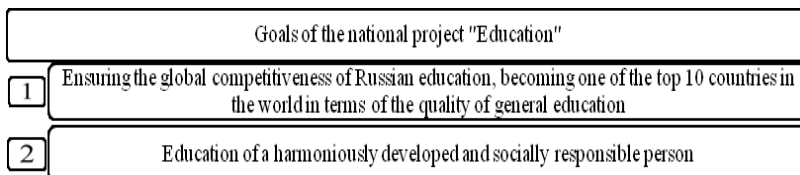
Figure 1 – Goals of NP.
Compiled by: the author according to the passport of the NP [5, p. 2].

Each goal in the inventory item passport has its own target indicators, according to which it is planned to characterize the implementation of the inventory item. In our opinion, these targets directly correspond to the goal. However, what exactly does a harmoniously developed personality mean and what criteria can be used to determine the harmony of personal development and the degree of its social responsibility? There is also a question about how exactly the involvement in the activities of public associations will be determined [5, p. 2-3].

To measure the achievement of the goal of educating a harmoniously developed and socially responsible person, a number of indicators are planned to be used as a target indicator. In our opinion, the targets specified in the project passport directly correspond to the goal. However, what exactly does a harmoniously developed personality mean and what criteria can be used to determine the harmony of personal development and the degree of its social responsibility? There is also a question about how exactly the involvement in the activities of public associations will be determined [5, p. 2-3].

The implementation of the NP is planned until 2024, but due to the Decree of the President of the Russian Federation No. 474 of July 21, 2020 «On National Development Goals of the Russian Federation for the period up to 2030», it will be extended until 2030, and the project objectives will be adjusted [8]. Initially, the financial support of the NP was supposed to be 784.5 billion rubles for the entire implementation period. The sources of these funds are funds from the federal budget in the amount of 723.3 billion rubles, funds from the budgets of the constituent entities of the Russian Federation in the amount of 45.7 billion rubles, and funds from extra-budgetary sources in the amount of 15.4 billion rubles [3], [5, p. 62].

Each NP consists of several federal projects (hereinafter – FP). So, in the structure of the NP at the moment, the following are highlighted:: "Modern School" (hereinafter – MS), "Success of every child" (hereinafter-SOEC), "Support for families with children" (hereinafter – SFFWC), "Digital Educational Environment" (hereinafter- DEE), "Teacher of the Future" (hereinafter – TOTF), "Young Professionals" (hereinafter – YP), "New opportunities for everyone" (hereinafter – NOFE), "Social activity" (hereinafter – SA), "Export of Education" (hereinafter – EOE), "Social Elevators for everyone" (hereinafter – SEFE). The budget of the NP is not divided among the federal ones in equal parts.

For a more accurate understanding of the goals and objectives of the NP, we will focus on a detailed analysis of the goals and objectives of each federal project separately.

For the entire period, it is planned to allocate the most funds for the financial support of the implementation of the FP «MS» – 295.1 billion rubles, or 37.62% of the total budget of the NP. This is explained by the main objectives of this project: updating the material and technical base of schools; introducing modern methods of teaching and upbringing; updating the methods of teaching the subject «technology». So, the tasks of this FP are: modernization of the infrastructure and material and technical base of schools; elimination of training in 3 shifts, ensuring the possibility of studying the field of «technology» in all subjects of Russia, etc.

FP "SOEC" is aimed at creating a system for identifying and educating the abilities and talents of children and young people. It is planned to allocate 80.5 billion rubles for this purpose. These funds will be used to finance the solution of a number of tasks involving the creation of centers, the modernization of the base for sports training, the creation of children's and mobile technology parks "Quantorium", etc.

The purpose of the FP "SFFWC" is the following: to create conditions for the beneficial education of children under the age of three years and to provide psychological, pedagogical and advisory assistance to parents of children receiving preschool education. For this purpose, such tasks were formed as the introduction of recommendations for providing information and educational support to parents, the creation of counseling centers to help parents. It is planned to allocate 8.6 billion rubles for this project.

FP «DEE» is aimed at achieving such a goal as creating a modern and secure digital environment. The project budget is 79.8 billion rubles and is aimed at solving the following tasks: implementation of the target model of the digital educational environment; introduction of modern digital technologies in the educational system; creation of networks of education centers; provision of 100% of educational organizations with the Internet, etc.

It is planned to allocate 15.4 billion rubles for the implementation of the FP "TOTF". The aim of this project is to introduce a system of professional development of teachers, and includes such tasks as improving the level of professional skills of teachers and teachers; creating a network of continuing education centers in all regions, etc.

FP "YP" is aimed at the modernization of vocational education. The budget of this project for the entire period of implementation is planned in the amount of 156.2 billion rubles. Its main objectives are to create a network of advanced vocational training centers and workshops with the latest equipment; to attract people who are trained in secondary vocational education programs to participate in various forms of mentoring; to improve

the skills of teachers; to introduce programs in the most popular and relevant professions at the level of Wordskills standards, etc.

The Federal Program "NOFE" is planned to allocate 9.2 billion rubles to achieve the following goal: the creation of a system that will provide an opportunity to continuously update and master new professional knowledge and skills, in other words, the modernization of the system of continuing education. To achieve this goal, the following tasks are formed: to attract at least 20% of scientific and pedagogical workers to participate in the implementation of continuing education programs; to pass continuing education programs for at least 3 million people in 2024; development and implementation of a system of grant support for higher education institutions in order to form and introduce modern continuing education programs, etc.

FP "SA" is aimed at creating conditions for the development of mentoring and support for public initiatives and projects. This project includes the following tasks: creating and implementing a system of social support for citizens who regularly participate in volunteer projects; conducting information campaigns to promote volunteerism; creating volunteer support centers based on educational organizations, non-profit organizations, state and municipal institutions, etc. It is planned to allocate 27.3 billion rubles for this purpose.

FP "EOE" includes two main goals: to increase the number of foreign citizens studying at universities and scientific organizations in Russia, and to implement a set of measures for their employment. It is planned to allocate 107.5 billion rubles for this FP. Its plan includes the following tasks: creation of a mechanism of state support for the promotion of Russian education abroad, including through the system of summer and winter schools; formation of an organizational and economic model for the creation and operation of the latest multifunctional student campuses; conducting an information campaign to attract foreign citizens to study in Russia, etc.

It is planned to allocate the least funds to the FP "SEFE" – 4.7 billion rubles, which is 0.6% of the budget of the entire NP. These funds are planned to be used to achieve the following goal: the creation of a system of professional competitions that provide opportunities for professional and career growth. In this project, it is planned to carry out such tasks as creating an online platform for providing a system of professional competitions and directly ensuring the conduct of competitions.

Based on the results of the analysis of the FPs that are part of the NP, we consider it important to note its significant role in the development of Russian education. So, this manifests itself in the following:

1. Every stage of Russian education is affected;
2. Additional and continuing education is affected.

It is also necessary to note the significant role of the NP "Education" in other areas of socio-economic development. Thanks to this project, in our opinion, it is possible to increase the potential of human capital in the Russian Federation, which can not but contribute to the growth and development of the country's economy. In addition, in many FPs, significant investments are planned in urban planning: construction and modernization of schools (FP "MS"), construction of student campuses (FP "EOE").

Considering the first results, we will focus on the results for the first two years of the implementation of the NP. In the first year, the federal budget funds were spent by 91.0% [7], and in the second year – by 91.0% [6]. One hundred percent fulfillment of the planned funds for 2019 was for the FPs: "SFFWC", "TOTF" and "SEFE", and for 2020 – FP "SFFWC" and FP "SA". The most incomplete execution was in 2019 for the FP "MS" - 83.5%, in 2020 for the FP "NOFE" – 64.6%. This percentage of disbursement of planned funds is not a satisfactory indicator. It is necessary to ask why the funds were not properly used. According to the conclusion of the Accounting Chamber of the Russian Federation, it is known that the problem of non-fulfillment of planned funds in 2019 is of an organizational nature [4, p. 35].

According to the results of the study, the author identified the following shortcomings to the content of the NP:

First, the wording of the goal and targets. The first stated goal of global competitiveness and becoming one of the top 10 countries in terms of the quality of general education seems to be somewhat inaccurately formulated, since the competitiveness of education is a broader concept than the concept of the quality of general education.

Secondly, the one-time updating of the material and technical base. To maintain the modern equipment of schools and their timely renewal, it is not enough to buy everything necessary for schools once and build a sufficient number of "Quantoriums", the material and technical base must be maintained and systematically updated. It is necessary to pay attention to the issue of financing educational institutions, as well as the issue of the distribution of this funding.

Third, the NP specifies the amount of financial support from extra-budgetary sources, but does not formulate the tools and mechanisms for their mobilization.

A special problem of the NP "Education" is the issue of motivation of direct participants in the educational process.

Considering the FPs components of the NP "Education", the author identifies the following problems:

First, the objectives of the FP "EOE" do not reflect the goals of the NP. They are not aimed at improving the quality of Russian education, but at popularizing education in Russia and creating an infrastructure to attract foreign students.

Secondly, the FP "EOE" has the task of implementing courses/disciplines in a foreign language, but it is not specified in which language or languages the courses and disciplines should be conducted.

Third, the NP lacks the task of teaching teachers a foreign language, especially given the task mentioned earlier. The item on the formation of foreign language courses for teachers should be included in the plan of the FP "TOTF".

A separate issue of the NP is the question of motivation. In our opinion, in the context of the NP «Education», it would be quite rational to pay attention to improving the skills of not only teachers, but also the management of educational institutions, since they directly work with the teaching staff and create incentives for the effective work of both teachers and students.

Concluding this article, it should be noted that the NP "Education" has both advantages and disadvantages that require further development and adjustment.

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Аннотация. В работе исследуется национальный проект «Образование» как инструмент программно-целевого управления бюджетными расходами на образование. Рассмотрены цели национального проекта «Образования», объемы его финансирования, а также раскрыто содержание федеральных проектов, включенных в состав национального проекта «Образования». Приведены итоги реализации национального проекта «Образование» за 2019 и 2020 года. Произведён комплексный анализ национального проекта «Образования», на основе которого выявлены его преимущества и недостатки.

Ключевые слова: национальные цели развития, Национальные проект «Образование», федеральные проекты, программно-целевое бюджетирование, развитие образования.

Annotation. The paper examines the national project «Education» as a tool for program-oriented management of budget expenditures on education. The objectives of the national project «Education», the amount of its funding, as well as the content of the federal projects included in the national project "Education" are considered. The results of the implementation of the national project "Education" for 2019 and 2020 are presented. A comprehensive analysis of the national project "Education" was made, on the basis of which its advantages and disadvantages were identified.

Keywords: National development goals, National project «Education», federal projects, program-target budgeting, education development.

UDC336.5

IMPROVING SOCIAL SUPPORT OF CITIZENS IN THE REGIONS OF RUSSIA RELATING TO THE CENTRAL FEDERAL DISTRICT

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One of the tools of the state's social policy is the system of social protection measures, which is guaranteed by the Constitution of the Russian Federation to every citizen, and is implemented with the help of a specially developed and adopted base of normative legal acts, and designed to provide every citizen, regardless of his religious and nationality, place of residence, gender and age, a standard of living corresponding to the minimum social needs, using various forms of social security. At the same time, first of all, it is necessary to provide support to the poor and those in need of assistance and state protection. The issues of ensuring and implementation of social protection measures are actively studied by scientists in scientific publications, including the provision of social protection measures at the regional level [1, 2].

In 1948, the UN Universal Declaration of Human Rights formulated basic human rights, including the right to social security, education, protection of motherhood and children, protection from unemployment, disability, and the right to state support in other cases of loss of funds to existence [3].

Decree of the President of the Russian Federation dated 07.05.2018 No 204 [4] approved the national goals and strategic objectives for the development of the Russian Federation for the period of 2024, which are primarily aimed at creating and ensuring a new quality of life for citizens, and are designed to solve the problems of increasing the reproduction of the population; increasing life expectancy to 78 years (by 2030 - up to 80 years); ensuring a decent standard of living - growth of real incomes of citizens, achievement of a rise in pensions above the inflation rate; reduction of poverty, improvement of living conditions.

On January 1, 2019, the Federal Law of October 3, 2018 No 349-FZ «On the Ratification of the Convention on Minimum Standards of Social

Security (Convention No. 102)» came into force, which covers all areas of social security. The document defines the size of monetary payments and the volume of services provided by the state, other key points in the field of social security [5].

The issues of social protection of modern Russia are given great importance in research. The researchers note that the existing system of social protection in modern conditions of economic instability is not able to fully ensure social equalization and protection of the most vulnerable segments of the population.

Using the example of the constituent entities of the Russian Federation belonging to the Central Federal District (hereinafter referred to as the CFD), we will consider the main differences and similarities of state guarantees of social protection of the population, provided through funding from the regional budget.

The socio-economic situation of 18 constituent entities of the Russian Federation included in the CFD is uneven. In the constituent entities of the Russian Federation of the CFD, there is a high diversification of the structure of the sectoral industry, the agricultural type of activity is not predominant. The district's internal needs are sufficiently met, which is reflected in the average income level of the population.

For 2018, the% increase in the unemployment rate in the Central Federal District is not observed, there is a positive downward trend (Fig. 1).

In 2019, the unemployment rate in the CFD continues to decline, while the share of the Central Federal District in the total volume of the Russian Federation in 2019 showed an upward trend of 0.72%.

	CFD	NFD	SFD	NCFD	VFD	UFD	SFD	FEFD
2015	17,47	8,44	12,81	11,7	17,43	9,52	15,38	7,26
2016	17,79	8,27	12,27	11,78	17,6	9,26	16,03	7,01
2017	17,42	8,07	12,46	12,64	18,01	8,95	15,19	7,26
2018	16,95	8,05	12,54	13,43	18,17	8,22	15,22	7,42
2019	17,67	7,67	12,42	14,70	17,89	7,82	14,49	7,34
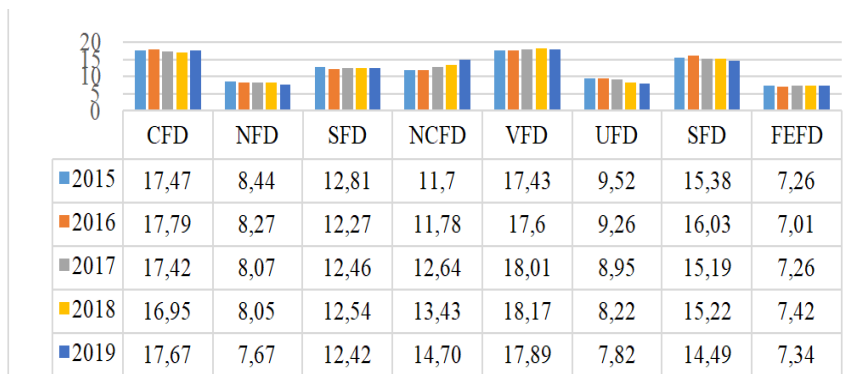
Fig. 1. The share of the number of unemployed by federal districts, in the total volume of the Russian Federation for the period 2015-2019
Source: compiled by the author based on Rosstat data [6].

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In the graph the following conventions are used: CFD – Central Federal District, NFD – Northwestern Federal District, SFD – Southern Federal District, NCFD – North Caucasus Federal District, VFD – Volga Federal District, UFD – Ural Federal District, SFD – Siberian Federal District, FEFD – Far Eastern Federal District.

On average, there is a decrease in the growth of the unemployment rate in the district, which is -2.7% compared to 2017, with the exception of the Belgorod region, which recorded a positive increase in the indicator in 2018 by 1.4% [7].

According to statistical data, 4 constituent entities of the Russian Federation of the Central Federal District out of 10 are in the list of 10 constituent entities of the Russian Federation, with the lowest unemployment rate at the beginning of 2019. Among them, the first place in terms of the lowest unemployment rate is held by Moscow - 1.3%; the fourth place is the Moscow region - 2.8%, the Voronezh region - 3.0% - 6th place, the Tver region is in the tenth place - 3, five %. This factor affects the standard of living of the population.

In the context of the constituent entities of the Russian Federation of the Central Federal District, the largest increase in spending on social security and the implementation of social policy is noted in Moscow (126%, 119%) and the Moscow region (108%, 110%), respectively. In the Kursk region, social security spending is in negative dynamics - 98%.

Given the amount of funds of the consolidated budget of the subject allocated for social support of citizens, per citizen, we note that in Moscow, the amount of funds exceeds more than 28 times the amount per citizen of the Belgorod region, the subject with the smallest volume funds for social support of citizens in the consolidated budget. At the same time, in the Belgorod region, the share of funds from the federal and regional budgets is approximately equal.

The largest amount of funds coming from the federal budget to finance social support measures is provided in the Moscow region (7.3% of the total amount of funds), in Voronezh, Yaroslavl, Vladimir, and in Moscow within 3-4.5%, in the rest of the subjects, the amount of funds coming from the federal budget does not exceed 3%, and in the bulk, it is below 1%. Accordingly, depending on the volume of funds received in the budgets of the regions, the volume of measures aimed at solving the issues of social protection of citizens also depends.

More than 98% of funds allocated for ensuring social protection of the population in all constituent entities of the Russian Federation of the Central Federal District are provided at the expense of the regional budget.

For the following categories of citizens, social support is provided by the smallest number of subjects of the Russian Federation in the Central Federal District: donors (5 subjects out of 18); military service veterans (5 subjects out of 18); persons with a low level of individual income (4 subjects out of 18).

Regional programs in the Central Federal District differ in the measures of providing social support, depending on the category of citizens. Only five subjects out of eighteen, including Moscow, provide assistance to citizens, in the category - donors, and in the category of citizens suffering from socially significant diseases, assistance is provided in four regions, and only in two regions: the Yaroslavl region and in Moscow, assistance is provided to both categories of citizens.

Among the measures of social support that distinguish the Central Federal District from other federal districts, the following can be noted.

Voronezh region. In addition to the standard category of citizens, measures of social support are provided to the following category of persons: honorary citizens of the Voronezh region and having special services to the region, in various production spheres; citizens suffering from chronic renal failure; young specialists of state and municipal cultural institutions; citizens participating in the maintenance of public order [8].

Vladimir region: volunteer firefighters and their family members; children of deceased (deceased) Olympic champions [9].

Tula region: children, inmates of orphanages in wartime [10].

Moscow region: persons of pre-retirement age who have reached 60 and 55 years old (men and women), persons who have reached 85 years old [11].

Moscow: families of retirees in which people under 18 live; pensioners who do not belong to other benefit categories; and others [12].

Based on the results of consideration of regional measures of social support for the population, implemented in the Central Federal District, it is possible to single out general problematic issues characteristic of all subjects of the Russian Federation of the considered district:

1. Insufficient information security. The lack of an information base containing a list of social projects and the main indicators of their performance implemented in the regions of Russia is a limiting factor in the effectiveness of the social policy pursued in the regions.

2. Limited budgetary funds. The volume of regional measures of social support of the population depends, in many respects, on the budgetary provision of the region, and the availability of additional sources of replenishment of budget revenues. In regions with a higher unemployment rate and low budgetary security, the volume of social

support measures is lower than in regions with a higher budgetary security, and, accordingly, a lower unemployment rate.

3. Regional measures of social support for citizens, in almost all regions that make up the Central Federal District, duplicate federal ones, thus, it can be concluded that there is no detailed methodology and information base containing information about citizens who really need state support, as well as the lack of control over the targeting of the measures provided.

Additional social assistance measures operate in many constituent entities of the Russian Federation of the CFD, differing only in the amount of support provided.

In the constituent entities of the Russian Federation of the CFD, there is a low birth rate, and therefore, the bulk of additional support measures in these regions should be aimed at improving the quality of life of large families with a large number of children, for purchasing things and school supplies, helping orphans, and children who find themselves in a disadvantageous situation.

Among the measures listed, the most popular is assistance to low-income families with schoolchildren, while assistance is provided not only as annual cash payments, but also various benefits in kind, such as:

- discounts on utility bills from 30%;
- providing children under 6 years of age with free medicines;
- priority admission to kindergartens;
- preferential or free public transport;
- provision of free school and sports uniforms;
- free admission to museums and exhibitions once a month;
- free breakfasts and lunches at school;
- the priority of providing children with a place in the summer health camp;
- benefits and compensation for payment for spa treatment.

As a reform of the existing system of providing social assistance to citizens, the author proposes to increase the availability and transparency of social support measures.

This can be realized through the use of modern technology of "digital twins" in the social sphere. With the availability of digitized information and a database of personal data, the use of the Internet and specially created portals for the provision of services can ensure accessibility and targeting, while increasing the efficiency of social support. For example, through online registration in kindergartens, schools, the provision of vouchers for spa treatment and summer recreation, etc.

One should also recommend organizing social support for families with many children and families with children in need of help, using the services of professional "grandmothers" - retirees, creating an appropriate service – "retired nanny", while a social effect will be achieved not only in the form of providing nanny services families with children, or with a disabled child, but also psychological relief for single people of retirement age, leading an active lifestyle, but at the same time, in need of basic communication.

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Аннотация. В исследовании отмечается, что в условиях нестабильной экономической ситуации, обеспечение социальной защиты граждан является государственной задачей стратегического значения. На основе анализа состояния и финансового обеспечения социальной сферы в Центральном федеральном округе Российской Федерации, выявлены наиболее проблемные направления, определены авторские пути их решения, связанные с обеспечением доступности и прозрачности мерсоциальной поддержки населению.

Ключевые слова: социальная поддержка, социальная защита, социальная политика, регионы, Центральный федеральный округ.

Annotation. The study notes that in an unstable economic situation, the provision of social protection of citizens is a state task of strategic importance. Based on the analysis of the state and financial support of the social sphere in the Central Federal District of the Russian Federation, the most problematic areas are identified, the author's ways of solving them are determined, related to ensuring the availability and transparency of social support measures for the population.

Keywords: social support, social protection, social policy, regions, Central Federal District.

UDC 336.5

WAYS OF SOLVING THE PROBLEM OF POVERTY IN THE RUSSIAN FEDERATION

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Currently, one of the most significant socio-economic problems of the Russian Federation is a fairly high level of poverty. Thus, according to official data presented on the website of the Federal State Statistics Service, the poverty rate in Russia has been stable at the same level for a long period (for the 1st quarter of 2020-12.6 % of the total population; this is clearly shown in Picture 1).

level for a long period (for the 1st quarter of 2020-12.6 % of the total population; this is clearly shown in Picture 1).
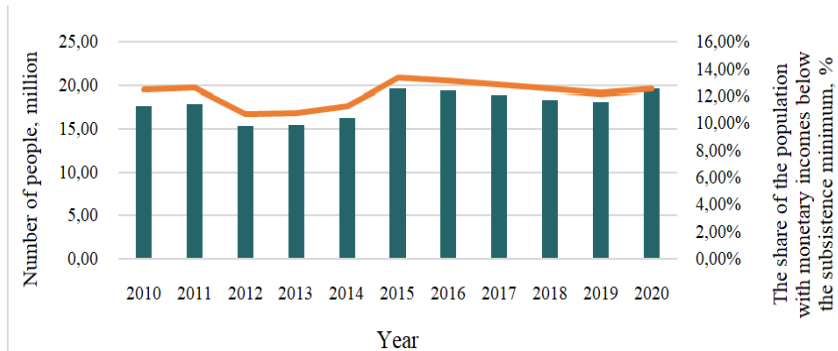
Picture 1 – Poverty indicator in the Russian Federation
Source: constructed by the author based on data from the Federal State Statistics Service [6]

The indicator shown in Picture 1, according to the "May" decree of 2018, was supposed to be reduced to 6.6% by 2024, but this period was extended until 2030 [6]. This fact once again confirms the difficulty of solving the problem of poverty in Russia. According to the Decree of the President of the Russian Federation "On the national development Goals of the Russian Federation for the period up to 2030" [8], reducing the poverty rate of the population is one of the key indicators for achieving the national goal "Preservation of the population, health and well-being of people". So, this indicator should be reduced by half compared to the indicator of 2017.

It is important to note that the President of Russia, in his annual address to the Federal Assembly of the Russian Federation on 21.04.21, identified the problem of poverty as "an acute problem that is a direct threat to our demographic future" [3]. In this regard, solving the problem of poverty is the most urgent task.

The problem of poverty in the Russian Federation, as well as in many countries of the world, plays a significant role in the development of the economy. The qualitative development of economic processes is currently impossible without a stable position in society. Thus, to build strategic plans

for the development of the state, first of all, it is necessary to pay attention to the standard of living of the population.

Thus, the current situation is tense since the indicators of poverty have remained at the same level for quite a long period of time. In addition, the coronavirus pandemic caused a drop in the monetary income of the population due to the downtime of a large number of enterprises, as well as the loss of jobs for many citizens. Also, according to the research of the Higher School of Economics, the share of the middle class, which due to the pandemic moved to the category of poor, was equal to 6.1% [4]. In this regard, the established market situation requires the rapid development and application of measures to reduce the number of poor people in the Russian Federation.

The main difficulty in overcoming poverty today is the fact that there is no single document aimed at establishing specific measures to address this problem. In this regard, to solve this problem, it is necessary to develop solutions.

First, to solve the problem of poverty in the Russian Federation, it is necessary to create a single document that will contain specific measures to achieve the established indicators that contribute to reducing the level of poverty. This document can be issued, for example, in the form of a federal draft of the national project "Demography". First, it should contain information about the concept of "poverty" and the methodology of its calculation (according to the author, a citizen who is not able to meet the minimum needs for life with the help of his income should be considered poor). The main goal of this federal project will be to reduce the share of the population with an income below the subsistence minimum and to reduce the poverty rate to 6.6% by 2030. The key indicators of this federal project, according to the author, should be the following:

real disposable income (%); the

degree of income differentiation by region (the share of the poorest and richest segments of society, in%); the

population with monetary income below the subsistence minimum (million people).

The action plan should include the following actions:

1. Creation of a new methodology for measuring poverty (not only by monetary income, but also considering the financial capabilities of citizens to consume a minimum set).

2. Identification of the group of citizens who are poor (to identify this group, the use of new indicators is required).

3. Definition of the category of citizens who belong to the intermediate group (citizens who can both leave the poor group and enter this group)

4. Creation of financial instruments to support citizens classified as intermediate and poor (introduction of food cards, professional development, financial support for poor citizens).

At the same time, a particularly interesting indicator that measures poverty is the ADOPE indicator used by Eurostat, which includes three indicators. It should be noted that the presence of two of these signs in a citizen already refers him to a poor person. The features include [9]:

1. The risk of relative monetary poverty (the definition of poverty, considering the average per capita income of a working-age citizen and comparing this indicator with the subsistence minimum).

2. The index of material deprivation (the proportion of the population who, due to the lack of money, cannot afford a certain set of products and services necessary for the implementation of the minimum living needs).

3. Exclusion from the labor market (a situation where an able-bodied citizen worked less than 20% of the labor potential at the end of the past year).

The methodology for calculating this indicator could be borrowed for use on the territory of the Russian Federation, but it is necessary to supplement this methodology with the establishment of intermediate requirements. For example, you can add the presence of residential premises in the property to the index of material deprivation. This step will help to analyze the category of citizens who are in the "border" zone, and their transition from poverty is carried out in fairly simple ways.

Secondly, in connection with this problem, it is necessary to develop new indicators or criteria that assess the impact of ongoing activities on achieving the goal of reducing the level of poverty to key indicators. For example, the indicator of changes in income differentiation by region, as well as people who are outside of poverty; the share of citizens who can overcome poverty soon and with minimal support. It is also necessary to constantly analyze these indicators for individual regions of the Russian Federation. This measure is necessary to describe the situation in each region and, if necessary, to create additional tools for solving emerging problems using" point-based " methods. The calculation of these indicators should be carried out by the territorial bodies of the federal state statistics when receiving data while conducting statistical observations, censuses, sample surveys, requests for data from the state authorities of the Russian Federation.

Another way to solve the problems of population poverty, according to the author, is the introduction of food cards for particularly needy citizens. However, here it is necessary to introduce some unsolved problems, without solving which this mechanism for supporting effective consumer demand

from the state cannot be implemented. Such limitations include: the lack of full-fledged information bases for assessing the degree of need, as well as a system for monitoring the use of allocated funds (for this purpose, according to the author, it is necessary to create a single information center connected with payment terminals in retail outlets).

It is important to emphasize that the introduction of cards can increase the demand for Russian-made goods, provided that these cards should be used only for the purchase of Russian-made goods.

In addition, one of the above-mentioned problems is the high level of citizens who do not receive state support, although their need for a group of citizens with an income below the subsistence minimum is clear. Currently, an e-government project is being developed on the territory of the Russian Federation, which focuses on the development of services for citizens. This system should facilitate the receipt of various types of social assistance to citizens in need. The state policy in the sphere of ensuring the growth of real incomes and reducing the level of poverty is not systematic, it lacks an information base and the development of targeting (as has been repeatedly noted in the scientific literature [1-2, 5]) to determine the needs of citizens more accurately.

Finally, according to the author, measures to reduce the unemployment rate are an important factor in reducing poverty. The solution to the problem of poverty cannot be achieved by simply raising wages without developing qualification components. In our opinion, the key link in solving this issue is the development of the education system (in the presence of a strong "basic school" - retraining, or training in special skills of the profession will not be difficult for most citizens). However, the development of the education system will not be able to give a quick effect, so, in our opinion, measures to improve the financial literacy of the population are coming to the fore. To implement measures to improve financial literacy, it is initially necessary to divide the population based on their financial goals, then create activities for each group to develop knowledge in the field of finance, considering certain early needs.

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Аннотация. В данной научной работе рассматривается проблема бедности в Российской Федерации, проводится оценка принимаемых мер по поддержке населения в период коронавирусной инфекции, а также указываются недостатки по сравнению с поддержкой в других странах. Автором предлагаются комплексные меры, которые способны решить проблемы бедности в Российской Федерации и достичь снижения её уровня к 2030 году.

Ключевые слова: бедность, национальный цели, социальная поддержка, продовольственные карточки, безработица.

Annotation. This research paper examines the problem of poverty in the Russian Federation, assesses the measures taken to support the population during the period of coronavirus infection, and identifies shortcomings in comparison with support in other countries. The author proposes comprehensive measures that can solve the problems of poverty in the Russian Federation and achieve a reduction in its level by 2030.

UDC 336.13

BUNDLE OF RECOMMENDATIONS FOR THE GOVERNMENT SECTOR ON EXPANDING DIGITAL TOOLS FOR ADDRESSED POPULATION SUPPORT DURING COVID-19 PANDEMIC

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During the period of coronavirus infection, the provision of state and municipal services through a variety of remote channels for obtaining them comes to the fore. One of the additional channels could be voice assistants. This tool has been successfully integrated into the Finnish social security system [5]. Aurora's voice assistant at the time of its launch in 2019 was focused on three main scenarios: moving a student to another city to study at a university, looking for continuing education courses, and supporting families with children. However, at the moment, this system claims to be the national leadership in the field of artificial intelligence.

According to the author, domestic information systems could become a platform for the introduction of voice assistants. The advantage of a social voice assistant is the ability to adapt to a specific person through neural network technologies that copy the neural networks of the human brain, which contributes to the formation of services based on the needs of a specific person at a certain point in time [6].

The service mechanism is reinforcement learning, during which the helper system learns by interacting with the environment. This technology is often used by both companies, for example, Sberbank, and government agencies in some countries. Within the framework of social security, this technology is able to determine the set of services that becomes most in demand among users and actively promote them. Thus, the voice service can provide various services: from choosing a medical organization and finding the nearest location of a vaccination point to selecting retraining and retraining courses.

Also, among the tools for reducing physical interaction between employees of public authorities and recipients of services, one can single out robo-advising. It is worth noting that this technology has become very popular in the corporate sector, however, in the public finance sector, robo-advising is still underestimated. Note that the introduction of robo-advising in government systems is not yet widespread, however, a number of European countries, in particular Great Britain and Germany, have already announced such intentions. The attractiveness of robo-advising lies in the number of benefits it has from using this tool in the public sector [7].

First of all, automation of labor-intensive and routine processes in the work of, for example, the Pension Fund of the Russian Federation, reducing the need for employee intervention will significantly increase the efficiency of budget expenditures of the state non-budgetary fund of the Russian Federation. The gradual introduction of this fin tech tool will not create an increase in unemployment, including through various programs for retraining and retraining personnel. However, it should be noted that it is not always possible to completely abandon "human consultations", and in addition to automated consultants, there is an opportunity for personal communication, but this opportunity is usually strictly limited. Such hybrid robo-advisers are largely determined by the cultural traditions of their clients, for example, platforms in the United States are usually fully automated, and in European models, an element of personal communication with a consultant is very common. Such preferences seriously counter the main advantage of robo-advising, increasing the cost of the platform [1, 3].

This ability to offer more affordable investment services at a lower cost due to the efficiency gains from process automation makes this technology attractive to the pension sector, which increases the availability of pension advice to previously underserved populations.

Reducing the time spent looking for information and getting advice also leads to an increase in attractiveness. On fully automated platforms, the client will need no more than 15 minutes to agree on information, set goals and output the result. Moreover, the service is available round the clock, which will attract those groups of the population for whom financial advice was previously unavailable due to employment. Due to convenient and simple user interfaces, platforms are becoming available to a wider audience with a low level of financial and computer literacy [4].

In addition, through robo-advising, you can create a special chat bot that will allow the user to quickly ask a question of interest, for example, about social support measures during a pandemic. This is especially important in the context of improving public administration [2].

The greatest development during the pandemic was received by projects for the creation of remote work and cloud services, the development and automation of public service systems, distance education, telemedicine, etc.

In these conditions, it is proposed to create a register of ready-made solutions, which will allow combining the best practices of the regions on the use of IT during a pandemic.

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Аннотация. в статье рассматриваются приоритеты цифровой трансформации сектора государственного управления в период пандемии. Автором сформированы предложения по расширению цифровых инструментов адресной поддержки населения в период пандемии COVID-19 в контексте модернизации государственного управления с учетом современных вызовов.

Ключевые слова: сектор государственного управления, информатизация, робоэдвайзинг, голосовые помощники.

Annotation. The article examines the priorities of the digital transformation of the public administration sector during a pandemic. The author has formulated proposals for expanding digital tools for targeted

support of the population during the COVID-19 pandemic in the context of modernizing public administration, taking into account modern challenges.

Keywords: public administration sector, digitalization, informatization, roboadvising, voice assistants.

IMPROVEMENT OF THE FINANCIAL MECHANISM OF PUBLIC INSTITUTIONS OF CHILDREN'S HEALTHCAREIN RUSSIA

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Health care plays an important role in the socio-economic development of the country and in improving the general level of well-being of citizens. Analyzing the role of medical institutions, their importance for maintaining a stable and efficient level of the economy, there is a need to revise the quality financing of health care.

In recent years, there have been a lot of studies on the modernization of the health care system [2-4], incl. in the context of the implementation of national projects [1]. However, they do not address issues in the field of child health.

To form the most objective results, let us consider the structure of the income of a medical organization using a specific example – the State Budgetary Institution of Healthcare of the Moscow Region "Podolsk City Children's Clinic No. 1".

So, figure 1 clearly shows the structure of the income of this institution. So, in particular, it should be concluded that income from the provision of paid services occupies a significant share in the structure, gratuitous receipts fill almost a quarter of all income. At the same time, various fines and penalties for damages are practically insignificant.
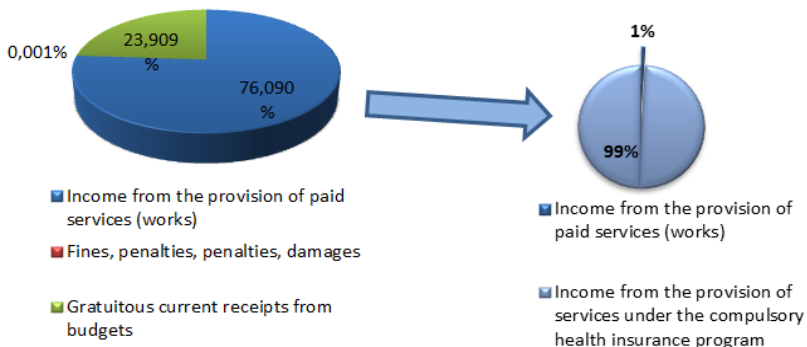
Figure 1 –The structure of income of the state budgetary health care institution of the Moscow region "Podolsk city children's polyclinic No. 1".
Source: built by the author based on the results of his own calculations based on official data [6].

Considering the fact that this institution receives more than 120 million rubles a year for the provision of services under the CHI program, it seems appropriate, first of all, to formulate proposals to improve the quality of medical care under the CHI program. So, according to the author, it is currently necessary:

1. Provide institutions with adequate modern infrastructure. This proposal is due to the lack of advanced technologies in many institutions, which complicates the process and quality of treatment.

2. To increase the growth of the performance of the medical institution's registry. At the same time, taking into account the problems noted by patients, it is necessary to bring the quality of everyday communication between the administrator and them to the level of a doctor's consultation.

3. Monitor the implementation of hygienic and sanitary standards. The organization is obliged to comply with the established sanitary and hygienic standards to reduce the spread of various viruses within institutions.

4. To systematize medical examinations of citizens in order to prevent emerging diseases. To do this, it is necessary to ensure regular notification of the population about the annual health preventive measures, thereby eliminating viruses as they arise.

5. Provide quick access to the full volume of information on available services (in particular, it is especially important to inform the population about the need to prevent their health).

In the context of the current financial and economic crisis, there is an active search for new financing instruments for the introduction of innovative treatment methods and improving the quality of medical services provided. Indeed, in conditions of limited budgetary funds, it is necessary to work on the development of extra budgetary sources. In particular, in order to increase the volume of income from paid services directly for this institution, the author of the article recommends the implementation of a number of measures.

First, it seems appropriate to use the mechanism for calculating benefits for paid services, taking into account visits. Patients who often use paid services need to introduce a system of discounts and benefits, as well as the ability to purchase a subscription.

Secondly, it is necessary to create an automatic acceptance of payment for services by bank cards, thereby saving payment time. So, it seems possible to make payments from home before making an appointment with a doctor. If it is impossible to determine the cost of the service, then within 2 working days after the admission, provide the possibility of remote payment for the service provided.

Thirdly, given the fact that a feature of children's clinics and hospitals is a new format of work and new organizational and planning solutions that increase the comfort of the conditions of stay of parents and their children, as well as the quality of medical care, it seems correct to create children's play areas for children. , the design of separate units on the territory of a medical institution for the provision of emergency care, which makes it possible to exclude close contact between healthy and sick children.

Fourthly, on a paid basis, parents may be given the opportunity to enroll their children in wellness sections, for example, a visit to the pool, which has a beneficial effect on the health of children.

Fifth, it is also possible to organize expeditions to places with medical children's sanatoriums and boarding houses.

Sixth, according to the author, it seems expedient to form a speech therapy studio for children.

In conclusion, it should be emphasized that the level of medical services provided directly forms the demand of the population. Therefore, it is required to increase the responsibility and competence of working personnel, provide institutions with all the necessary high-tech equipment, and also apply only those methods that have proven their effectiveness and safety in scientific research.

This approach will have a beneficial effect on the general standard of living of the population, and the latest technologies will help improve the

quality of medical services in the field of children's health care and stabilize the situation with childbirth and demography, thereby solving socio-economic problems in the country and ensuring the achievement of national development goals determined by the President of the Russian Federation until 2030.

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Аннотация. Статья посвящена совершенствованию финансового механизма учреждений детского здравоохранения в Российской Федерации. Исследование базируется на фактических данных о деятельности Подольской детской поликлиники, на основании которых сформулированы предложения по совершенствованию её финансового механизма.

Ключевые слова: здравоохранение, детское здравоохранение, социальная сфера, финансирование социальной сферы, финансовое обеспечение социальной сферы, бюджет.

Annotation. The article is devoted to improving the financial mechanism of children's health care institutionsin the Russian Federation. The study is based on factual data on the activities of the Podolsk Children's Polyclinic, on the basis of which proposals were formulated to improve its financial mechanism.

Keywords: health care, children's health care, social sphere, financing of the social sphere, financial support of the social sphere, budget.

UDC 336.5

REVIEW OF THE BUDGET EXPENDITURES OF THE PENSION FUND OF THE RUSSIAN FEDERATION FOR 2016-2020

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The Budget Expenditure Review (hereinafter referred to as BER) is one of the modern tools gaining popularity in the international practice of result-oriented budgeting. Several authors pay attention to this tool as one of the stages of increasing efficiency of budget expenditures in the global and Russian practice. So, Robinson M. draws attention to a special role of BER at the stage of budget planning of the state, and also notes that a key role in such an instrument should be given to qualitative preparation of the information base, on the basis of which BER will take place, as well as criteria for evaluation of information, which finally form the basis for making recommendations and implementing these recommendations in the budget process of the country [6]. S.P. Solyannikova, O.V. Bogacheva, O.V. Smorodinov, N.O. Bondarenko examine the history of development of BER mainly in European countries, dividing it into 2 basic stages: before and after economic crisis of 2008-2009 [4, 5].

However, a key shortcoming of these scientific publications is the lack of consideration of the processes already initiated by the Ministry of Finance of the Russian Federation in the field of development and application of BER.

It is worth mentioning that the beginnings of BER in the world were made at the end of the 20th century due to the growing deficits of the European states. However, the active introduction of this instrument comes after the financial crisis of 2008-2009 with the aim of reducing (controlling) the continuous growth in expenditure.

To date, several models of BER have emerged in world practice:

a) «bottom-up», where cost analyses and savings options are developed by line ministries and the Ministry of Finance and other external actors provide additional recommendations for savings based on the prepared cost analysis (Canada and the UK);

b) «top-down», where line ministries provide information and the Ministry of Finance or a working group made up of ministry staff and external actors conducts the review (France and Italy);

c) «average» model, where a working group is set up comprised of representatives of line ministries and the Ministry of Finance, and the approval of the report is also determined by a joint power authority (The Netherlands and Denmark) [10].

An important role in the review process is to motivate line ministries to provide objective and complete information that will be requested.

The Russian practice has been implemented since 2018, when the Ministry of Finance of the Russian Federation (hereinafter referred to as the Ministry of Finance of Russia) conducted two pilot expenditure reviews and also prepared a Procedure for conducting budget expenditure reviews.

So far, the Russian Ministry of Finance has prepared and published 5 reviews of budget expenditures [8], from the study of which the author was able to form the notion that the Russian approach analyses the expenditure line data in detail and with due justification forms problem areas that need to be addressed. The key shortcomings, according to the author, are the small number of solutions to a large list of problem areas, and the citation of data that cannot be found in the public domain, which significantly limits public scrutiny of accuracy and credibility.

The author considers of the Russian Pension Fund (hereinafter - PFR) to be important, as only one conducted by the Ministry of Finance of Russia considered the state extrabudgetary funds, but even it does not provide data on budget expenditures and recommendations for their optimization, but only "in places" mentions that "similar is observed in the state extrabudgetary funds". In the author's opinion, it is the optimisation of budget expenditures of state extra-budgetary funds that should be given a separate emphasis, because these funds serve social risks that are directly related to the citizens of our country. Given the PFR budget deficit, the increase in the number of pensioners over 46 million people (as of January 1, 2020) [9], the need to improve the Russian pension system [1-3], its implementation seems particularly significant.

The author chose the PFR budget for 2017-2019 [8] to conduct the OBR. In 2019, the increase in expenditures relative to 2018 was 203,543.1 million rubles, or 2.4% (relative to 2017, by 168,373.2 million rubles, or 2%). The changes are due to the increase in expenses for pensions in 2019 by 326,915.7 million rubles, or 4.44% (by 446,244.5 million rubles, or 6.2%) as compared to 2018, as well as other expenses that had a smaller increase in the years analyzed. Budget execution is also high, at 96.7% in 2017 and 99.1% in 2018 and 2019.

According to Federal Law No. 167-FL of 15 December 2001 "On Mandatory Pension Insurance in the Russian Federation", the PFR budget funds are earmarked and allocated for the purposes specified therein. Based on the main areas of spending specified in the federal law, it can be concluded that the main expenses should be payments under pension provision, logistical support and performance of functions, but funds are also spent for other purposes from the fund's budget:

‒ In 2019, 26 payments were made (a year earlier - 25) under pension provision, with only 11 payments showing a decrease in expenses compared to 2018 (the largest decrease in 2019 is noted in expenses for the provision of a one-off payment of pension savings by 14.2%, and in 2018 in expenses for the federal social supplement to pensions by 5.1%). *A problem area is inaccurate planning of expenditure on pension benefits.*

‒ There is an increase in 2019 in relation to 2018 (4.5%) as well as in 2018 in relation to 2017 (5.8%) due to a number of measures taken by the government (indexation of pensions for non-working pensioners and adjustment of pensions for working pensioners) and an increase in the number of pensioners. It is also important to note the high quality of budget planning in 2017-2019 in determining the costs of insurance pension payments - between 99.1% and 99.9%.

‒ As part of the social security of the population, the PFR makes 20 types of social payments. The funds for such payments are provided from inter-budgetary transfers (hereinafter referred to as IBT) from the federal budget (hereinafter referred to as FB). In the analyzed years these financial resources make up from 42% to 44% of the total volume of inter-budgetary transfers from the federal budget. *The problem area is the existence of expenditure obligations of the Russian Federation fulfilled at the expense of the PFR budget funds received from the FB through the provision of IBT for the provision of social benefits to citizens. In the opinion of the author of the article, this contradicts the main purpose of the state extra-budgetary fund.*

‒ Spending on the monthly cash payment (hereinafter referred to as the MSP) decreased in 2017 (1.3%) due to a decrease in the number of recipients and increased (2.3% in 2018 and 1.3% in 2019) due to annual indexation, while there has been an annual decrease in the number of MSP recipients from 1 January 2017 to 1 January 2020, mainly due to a decrease in the number of disabled people. *Problem area: this payment is not pension provision. Moreover, it is necessary to comprehensively check the reduction in the number of UDV recipients, as there is an assumption that such a sharp decline in the number of recipients of this payment is due to the denial of disability status to citizens (according to Rosstat, the*

number of people with disabilities decreased by 386 thousand people in 2017-2019, while the number of people recognized disabled for the first time declined annually in the analyzed period from 56.5 people per 10,000 population in 2017 to 54.6 in 2019 [9]).

– Disbursements for provision of the maternal (family) capital are decreasing over the analysed period (2017 - 14.7%, 2018 - 3.1%, 2019 - 3.5%), despite the fact that the amount of the family capital itself has not decreased. The reason for the decrease is that the number of issued certificates is decreasing from 727,16 thousand in 2017 to 617,80 thousand in 2019, or by 15%. At the same time, the number of families applying for the use of maternity capital is increasing every year and amounts (in thousands of families): in 2017 - 869.28; 2018 - 925.88; 2019 - 949.93. *Problem area: insufficient quality assessment of the number of applicants for the use of maternity capital (according to the PFR, 1.5 trillion roubles have not been used by citizens who have a certificate) the need for additional information for citizens about maternity capital and its possibilities.*

– In terms of the expenditure classification sub-items, the highest implementation rate of the PFR budget is under pension provision (99% over the 3 periods analyzed) and the lowest implementation rate under applied research in the field of social policy (2017 – 44%, 2018 – 73%, 2019 – 33%) (Figure 1).

– Reduce the number of payments transferred to the FIU (in international practice, such payments are made by line ministries, e.g. in the Federal Republic of Germany, child payments are made by the Federal Employment Agency, subordinated to the German Federal Ministry of Labour and Social Affairs). This measure leads to focus and concentration on the core business of the extra-budgetary fund.

In view of the problem areas identified, it is proposed that:

– Improve the quality of cash execution of certain types of expenditures, including through increased control by the FIU and other supervisory bodies, applying sanctions for failure to achieve results within the established timeframe. At the same time, it is proposed to create a list of unscrupulous contractors who will not be dealt with in the future.
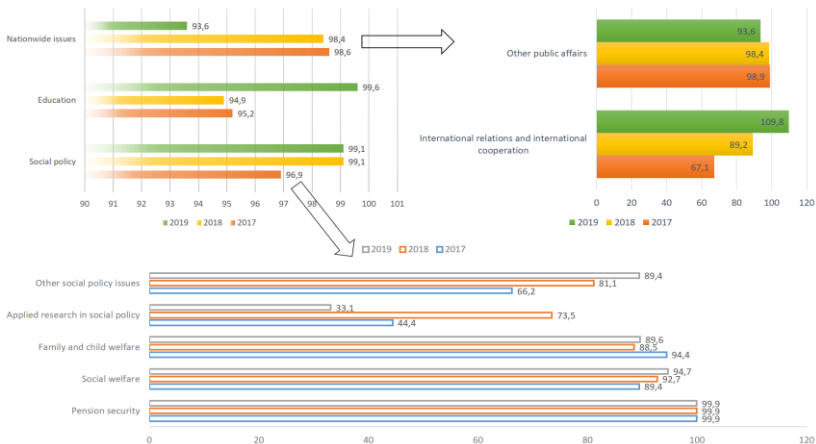
Figure 1 – Execution of the PFR budget by main sections and
subsections of the expenditure classification (%)
*Source: compiled by the author on the basis of the PFR budget
execution data for 2017-2019 [7].*

- Improving the quality of budget planning by developing long-term budget planning of the state extra-budgetary fund, as well as introducing program budgeting based on setting goals, objectives and targets. In particular, it is necessary to "revive" the state programme for the development of the pension system using programme-targeted methods and introducing target indicators that affect not only the quality of services provided, but also to optimise budget expenditure in order to reduce and avoid the PFR budget deficit in the future.

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Аннотация. В статье рассматривается важность обеспечения развития бюджетирования, ориентированного на результат с учётом передового зарубежного опыта использования обзоров бюджетных расходов. Сделан вывод об отсутствии их по отношению к бюджету Пенсионного фонда Российской Федерации. Представлены результаты проведенного автором обзора расходов бюджета Пенсионного фонда Российской Федерации с выделением основных проблемных областей и предложений по их устранению.

Ключевые слова: обзор бюджетных расходов, Пенсионный фонд Российской Федерации, программно-целевое управление, пенсионное обеспечение.

Annotation. The article discusses the importance of ensuring the development of performance-based budgeting, taking into account the best foreign experience in the use of budget expenditure reviews. It is concluded that they are absent in relation to the budget of the Pension Fund of the Russian Federation. The article presents the results of the author's review of the budget expenditures of the Pension Fund of the Russian Federation, highlighting the main problem areas and proposals for their elimination.

Keywords: review of budget expenses, Pension Fund of the Russian Federation, program and target management, pension provision.

UDC 336.1
THE STATE OF THE ENVIRONMENT IN THE RUSSIAN FEDERATION: IDENTIFICATION OF PROBLEMS AND DEVELOPMENT OF ECONOMIC MEASURES TO SOLVE THEM

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The current economic activity of human has a very strong negative impact on nature, since it is somehow connected with the use of various types of wealth and resources (water, forest, etc.), which results in various waste and pollution. For example, enterprises of the metallurgical industry are the most polluting, accounting for about 30% of environmental pollution (emissions of industrial waste, emissions of dust, slags and gases that have a negative impact on vegetation, on the soil of the earth, on fresh water sources, etc.) [4, p. 275]. Next type of production in the share of the total level of pollution is the energy industry: hydroelectric power plants, thermal power plants, nuclear power plants, etc. They have a negative impact through thermal, radiation and toxic contamination of the environment. Also of great concern are such areas as mechanical engineering (a feature of production is the use of technological and raw materials resources that have a negative impact through the release of waste) and oil production (since each stage of the technological cycle of oil production and processing is associated with a danger to the environment: climate change, water pollution, soil and rock pollution, as well as associated with the release and release of hazardous components: ammonia, acids, hydrocarbons, etc.).

Thus, an increasingly important factor in the development of the national well-being of a particular country and its inhabitants is to ensure environmental safety. This problem is global and requires serious cooperation between national authorities and international organizations.

At the same time, there are quite a lot of problems in the Russian Federation, which is confirmed by the data of the rating of the most environmentally friendly countries in the world, which is compiled every year by the Center for Environmental Policy and Law at Yale University (Yale Center for Environmental Law and Policy). The Russian Federation is on the 58th position with a score of 50.5 points, while the leader of the

rating has 82.5 points [10], which indicates the presence of an unfavorable environmental situation in our country.

It is worth noting that there are many reasons for all environmental problems in the Russian Federation, which can be grouped into several groups:

1. Structural: lack of infrastructure for waste management, inefficient use of various types of resources (for example, huge amounts of energy use);

2. Financial and economic: saving on environmental protection measures, using low-quality raw materials and fuel, priority of achieving economic indicators at the expense of environmental ones;

3. Control and institutional: insufficient control over deforestation and animal safety, which ultimately lead to inefficient use of natural resources, insufficient coordination of actions of public legal entities, enterprises and citizens on legislative issues, as well as in the framework of determining effective mechanisms in management activities aimed at protecting the environment;

4. Socio-ideological: low level of environmental awareness of the population, as well as environmental education and upbringing.

As practice shows, the financial support of state (municipal) expenditures on environmental protection in the Russian Federation is carried out on a residual basis. This is confirmed by the data of the Ministry of Finance of the Russian Federation: for 2019, the amount of federal budget expenditures on environmental protection amounted to 219.4 billion rubles, and for 2020, 301.7 billion rubles. Thus, the share of environmental protection expenditures in the total amount of federal budget expenditures is 1.2% for 2019 and 1.3% for 2020, respectively [5.6], which is clearly shown in Figure 1.

There is no doubt that our country needs to make every effort to ensure a high level of environmental safety: to reduce the generation of waste and pollution, limit harmful emissions, the most efficient use of natural resources, and much more.

In particular, the author suggests a number of measures to solve the identified problems:

First, to improve the ecological culture of the population and increase environmental education by combining the efforts of citizens, economic entities and the state, including through public-private financing of environmental protection.

The main factor, the main mechanism for overcoming the above-mentioned problems (their solution will eventually lead to sustainable economic growth) is the ecological culture of the population. The ecological

culture of a person is understood as his attitude to nature and ecology, the level of perception of these categories.
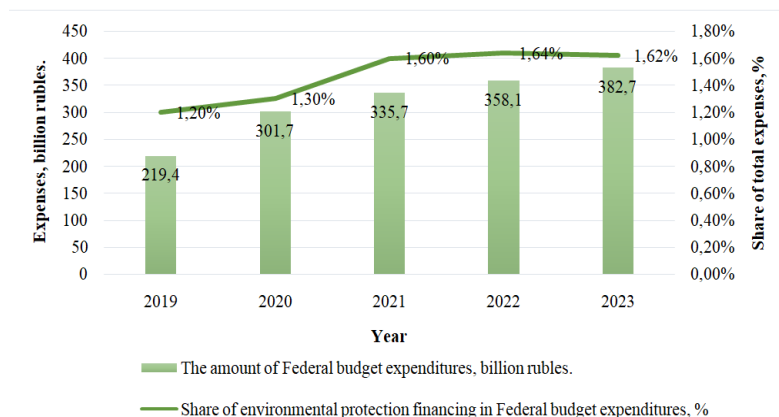
Figure 1 – Financial support for environmental protection at the expense of the federal budget

Source: compiled by the author on the basis of official data [5, 6]

In our country, to our deep regret, we can observe a relatively low level of environmental culture, which is confirmed by many problems, insufficient funding, as well as insufficient coordination of actions of public legal entities, enterprises and citizens.

Secondly, the change in the worldview of the population. Currently, socio – economic, rather than socio-ecological, factors of development are of primary importance in Russia. The efficiency of production development, the increase in economic indicators is a higher priority than the socio-environmental assessment of these growth indicators. Therefore, for the development of ecological culture in the country, it is necessary to shift priorities from economic indicators to environmental aspects of development.

Third, an increase in the investment factor aimed at protecting the environment. Currently, "clean technologies" occupies the 3rd position in terms of investment [9]. Multibillion-dollar companies spend their money on the development of new ideas, on the development of "clean technologies" and on the development of startups in this area. Investments in environmental projects are primarily aimed at preserving natural resources, reducing environmental pollution, mitigating the effects of climate change, etc. At the same time, the issuer of this type of bond significantly reduces environmental risks. The state also plays an important role in this (subsidies, taxes, various standards, etc.), so it is important to

provide state support for financing and stimulating the development of these projects.

Fourth, the active introduction of "green" financing tools in Russia. "Green" financing is an effective tool for financial support of environmental projects, which is actively developing both around the world and in our country. In 2019, the first platform in the Russian Federation to support various environmental projects, listed on the Moscow Stock Exchange, was launched. At the moment, the register of green bonds of Russian issuers includes 5 companies, the total amount of issued bonds of which amounted to 7.55 billion rubles for 2020 [7]. It should be emphasized that $257.5 billion worth of bonds were issued on the international market in this year [11].

Thus, environmental problems are a topic that takes on a more global meaning every year. It becomes obvious that the further development of technological progress is impossible without addressing the environmental situation. The solution of environmental problems, in turn, is impossible only at the national

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Аннотация. Актуальность исследования обусловлена тем, что в настоящее время проблемы экологии и защиты охраны окружающей среды выходят на одни из первых мест по значимости и необходимости решения во всём мире (в т.ч. и в Российской Федерации). По результатам исследования определены ключевые экологические проблемы, их причины, а также сформулированы меры, направленные на их решение. В частности, автором были сделаны выводы о необходимости качественного и количественного их увеличения для улучшения экологической ситуации у нас в стране.

Ключевые слова: экология, природопользование, экологические проблемы, охрана окружающей среды, экологическая безопасность, зеленое финансирование, устойчивое развитие

Annotation. The relevance of the study is due to the fact that at present the problems of ecology and protection of environmental protection are among the first places in terms of importance and need to be solved all over the world (including in the Russian Federation). Based on the results of the study, the key environmental problems, their causes, and measures aimed at solving them are identified. In particular, the author drew conclusions about the need for a qualitative and quantitative increase in them to improve the environmental situation in our country.

Keywords: ecology, nature management, environmental problems, environmental protection, environmental safety, green financing, sustainable development.

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MANDATORY AND INTERNAL BANKING RULES APPLICABLE TO E-BANKING OPERATIONS.

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Banking is a competitive sphere that demands its members to keep up with all new technologies. The Internet provided banks with an easy and convenient way to manage operations with money. E-banking is rather popular in Russia as far as the territory of the country is big and people prefer to save their time by not visiting bank's office but using gadgets to access their bank account.

According to the statistics of financial affordability presented by the Bank of Russia total amount of bank accounts with remote access has increased from 24,5% to 26,3% in 2019 [1, p. 2]. Other research results show that the amount of operations without the consent of banks' clients has raised too: from 163310 to 180352 [2].

Nevertheless, mandatory regulation of e-banking lags. There are no direct legal rules concerning banking operations on the Internet. The Bank of Russia provides certain recommendations to credit organizations to prevent fraudulent operations. In the information letter of the Bank of Russia of March 31, 2008 № 36-T are enumerated legal risks of e-banking application[3]. One of them is "imperfection of the legal system".

The legislator hasn't yet included the term "e-banking" into key federal laws on banking: Federal Law "On the national payment system" of June 27, 2011 № 161-FZ [4] and Federal Law «On Banks and Banking Activity» of December 2, 1990 No. 395-1 [5]. In the information letter of the Bank of Russia of March 31, 2008 № 36-T the term «e-banking» is stated: «*e-banking* – remote banking service method practiced by credit organizations on the Internet (as well as websites on the Internet) and including informative and operating interaction with them» [3]. However, the information letters of the Bank of Russia are not binding. This gap in law results in maladministration of remote banking and, therefore, fraudulent operations with bank accounts.

Internal bank regulation applicable to e-banking includes user agreements. In such documents banks state that they are not responsible for any wrongful operations with clients' bank accounts. For example, an extract from **Sber Bank**'s user agreement: "*Under no circumstances will the Bank be liable to the User for losses, including any direct, indirect, intentional, accidental or subsequent losses of any nature arising from this Agreement or from the use or inability to use the Bank's Application (including, but not limited to, losses incurred as a result of loss of business reputation, termination of work, technical failure, accident or malfunction or any commercial losses, costs or losses, as well as loss of profits or unjust enrichment) even if the Bank knew or should have known about the possibility of such damage or the User was warned about the possibility of such damage*" [6, p. 6].

VTB Bank: "*The Bank is not responsible for all Operations using the Card and/or its details (or several Cards) using the Mobile app, performed by other (third) parties with or without the knowledge of the Client*" [7, p. 7].

Alfa-Bank: "T*he user is responsible for all operations carried out in the Mobile Bank*" [8, p. 86].

Notwithstanding, there are certain measures taken by banks to prevent fraud. The Bank of Russia issues statistics, information letters, reviews concerning e-banking.

In 2019 was issued a new regulation "On the establishment of mandatory requirements for credit institutions to ensure the protection of information in the implementation of banking activities to oppose the implementation of money transfers without the consent of the client" (the Bank of Russia, April 17, 2019 г. N 683-П) [9]. According to this document have been established requirements for ensuring the protection of information in the course of banking activities. The goal is to prevent transfers of customer funds without their consent. The explanation of the secured information is given in the mentioned regulation. Secured information is the information mentioned in e-messages: the ones sent by the bank's client or the employee of the organization. Authorization information is client's login and password, for example. Information about provided bank operations is considered as secured information as well. Information of cryptographic keys is the cyphered client's information.

The Bank of Russia has introduced in February 2021 some methodological recommendations as well ("Methodological recommendations for reinforcing information work with clients by credit organizations to counteract unauthorized transactions" of February 19, 2021) [10]. These recommendations suggest credit organizations to:

1. Use methods that provide for the most effective client informing;

2. Check on what was done regularly (no less than once half a year), etc.

3. Inform clients about risks of unauthorized transactions by presenting information in the app, on the screens of ATM machines, on websites, in social media, in the offices and during phone calls; SMS mention the topic in the advertising of a credit organization.

There is also a website run by the Bank of Russia called «Financial culture»which includes the "Caution: frauds!" column [11]. In this subdivision can be found many articles such as «Steps to be taken if''money is stolen from your bank account", "Credit cards fraud online", Social engineering: why people themselves give money to the frauds, etc. Fraud-warning short videos created by the Bank of Russia can be found not only on Youtube [12] but in the metro as well: in modern trains, there are tv screens that transmit news, educational videos, and entertaining programs.

Credit organizations are quick to follow the Bank of Russia's instructions. Sber Bank's "Caution: frauds!" blog[13] provides articles and some videos to help people avoid being caught by frauds' lies. Raiffeisen [14], Alfa [15], VTB [16] banks have informative instructions on financial security as well.

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Аннотация. В статье прослеживаются основные аспекты регулирования операций интернет-банкинга как на законодательном уровне, так и на уровне внутреннего регулирования компаний, включая федеральные законы, информационные письма, положения и методические рекомендации Центрального банка Российской Федерации, пользовательские соглашения кредитных организаций, поднимается вопрос о пробелах в законодательстве, вызванных быстрым развитием технологий в банковском обслуживании, упоминаются действия, предпринимаемые Центральным банком Российской Федерации и кредитными организациями, такие как ведение блогов, предоставление видеороликов, представление

методических инструкций и комплексное информирование клиентов для решения проблемы несанкционированных транзакций.

Ключевые слова: Интернет-банкинг, банковская деятельность, защита информации, финансовая безопасность, защищенная информация, юридические риски, несанкционированные транзакции, мошенничество, информирование клиентов.

Annotation. The article traces major regulation of e-banking operations both on mandatory and internal levels including Federal Laws, the Bank of Russia's information letters, regulations, and methodological recommendations, and credit organizations' user agreements, raises the issue of law gaps caused by fast-developing technologies in banking service, mentions the actions taken by the Bank of Russia and credit organizations such as presenting of blogs, provision of videos, presentation of methodological instructions and comprehensive client informing to tackle the problem of unauthorized transactions.

Keywords: E-banking, banking activity, protection of information, financial security, secured information, legal risks, unauthorized transaction, fraud, client informing.

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ANTIFRAUD IT-PLATFORM AS UNIQUE RUSSIAN SOLUTION FORSECURITY OF E-BANKING OPERATIONS

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In the absence of legal regulation, in the context of a pandemic there was an increase in the number of financial transactions carried out through mobile banks during 2020 and so an increase the number of cases of fraud using online banking. That is why mobile operators and banks independently tried to create a system that would counteract fraudulent actions through e-banking and ensure the safety of funds in the accounts of bank's clients. Several major Russian banks and mobile operators tested the so-called anti-fraud platform in the first quarter of 2020 [1]. According to the resultsof testing, Tinkoff Bank and mobile operators Tele2, Megafon, MTS and Tinkoff Mobile launched the Tinkoff Call Defender platform.

Why Tinkoff Bank? **Tinkoff is the third largest bank in the country by the numberof active customers** [2]**.** It's also one of the world's biggest

online banks with over 12 million customers. 80% of High Quality employees are IT specialists, so the bank specialized on machine learning, artificial intelligence and biometrics. Therefore, it is not surprising that Tinkoff Bank was the first to launch an anti-fraud platform.

How does the platform work? The anti-fraud platform provides for real-time data exchange between the bank and mobile operators [3]. Prior to the launch of the platform, the bank transmits a database with the numbers of bank employees and a database of fraudulent numbers that is generated by the bank itself and the bank's clients through its website or mobile app to the mobile operator. With the launch of the platform by using special software at the time of the call there is automatic data synchronization during which the mobile operator can see whether a call is made with a number substitution.

What is number substitution? As the head of the Information Security Department of Searchinform company Alexey Drozd explained, when A person calls B person, B can see the phone number that appears on his smartphone screen [4]. This is called the Caller ID. It can be changed. This is what fraudsters use, replacing their Caller ID with a short bank number, for example, 900 (the number of one of largest Russian Banks - Sber). Therefore, a bank clients, seeing a call whose Caller ID is the same as the bank's one, they believes that they are actually being called by a bank employee.

Now let's return to the role of the mobile operator in the working of the platform. The operator either sees the fraudulent number from Database 2 and then interrupts the call or sees the substitution of the number and trough platform sends the request to the bank to find out whether the call was initiated by the bank. If no confirmation of authenticity is received, the platform registers the number as fraudulent and sends a message about it to the bank. This signal can serve as a marker to protect the client's funds from unauthorized debiting. For example, Tinkoff Bank may suspend atypical bankcard transactions after a suspicious call to a customer until the circumstances are clarified. According to Tinkoff Bank, Tinkoff Call Defender allows you to determine the nature of various types and scenarios of fraudulent calls, including number substitution, in 8 out of 10 cases.

As we learned from the interview with the representative of Searchinform company, another solution to the problem is possible if the platform could automatically search the first minute of a phone conversation for the presence of standard necessary phrases that are used by fraudsters such as "I am a bank employee", "there is suspicious activity on your account", "someone is trying to issue a loan to you" and so on. The platform could search for a set of words and, if there are enough of them, identify the call

as fraudulent and suspend it. Such a solution would be effective for older people who despite of the bank warnings still believe fraudsters and call them their personal data. Nevertheless, this raises the question of security of personal data that may be violatingby such an interference in conversations. Therefore, the anti-fraud platform remains the most developed solution to the problem.

It should be noted that the working of Tinkoff Call Defender applies only to clientsof Tinkoff Bank, who at the same time are clients of mobile operators involved in the project. A number of other major banks also announced the launch of their own anti- fraud platforms in the third and fourth quarters of 2020, but did not disclose the content of it. As the representative of the mobile operator Tele2 correctly noted [1] "the valueof the anti-fraud platform increases due to the consolidation of the subscriber bases of all major mobile operators". The same applies to banks. The effectiveness of the whole system can be significantly increased if it is extended to the entire territory of the country by creating a single anti-fraud platform.

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Аннотация. В статье представлено понятие системы антифрод-платформы, созданной в результате сотрудничества одного из крупнейших российских банков и ряда крупных операторов мобильной связи, описан механизм ее функционирования, путем введения понятий обмена данными в режиме реального времени и подмены номеров, приводится мнение ИТ-специалистов в сфере информационной безопасности о работе платформы и альтернативных решенияхпроблемы мошенничества в сфере электронного банкинга, а также высказывается идея создания единой антифрод-платформы на

государственном уровне путем обязательной для всех крупнейших банков и операторов мобильной связи страны консолидации как способа повышения эффективности системы.

Ключевые слова: безопасность при совершении операций с использованием интернет банкинга, антифрод-платформа, обмен данными в режиме реального времени, подмена номера, идентификатор вызывающего абонента, мошеннический номер, безопасность персональных данных

Annotation. The article presents the concept of the anti-fraud platform system created by the cooperation of one of the largest Russian banks and major mobile operators, describes the mechanism of its operation by introducing terms of real-time data exchange and number substitution, provides the opinion of IT specialists in the information security sphere about the work of the platform and their alternative solutions to the problem ofe-banking fraud and also expresses the idea of creating a single anti-fraud platform at the state level by mandatory consolidation of all the largest banks and mobile operatorsof the country as a way to improve the efficiency of the system.

Keywords: security of e-banking operations, anti-fraud platform, real-time data exchange, a number substitution, Caller ID, fraudulent number, security of personal data

TARGETED SOCIAL SUPPORT MEASURES FOR FAMILIES WITH CHILDREN IN THE RUSSIAN FEDERATION: EXISTING PROBLEMS AND SUGGESTIONS FOR THEIR SOLUTION

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One of the most important strategic tasks of modern Russia is the preservation of the population and ensuring its well-being, including the reduction of its poverty level (figure 1). In the context of existing demographic problems and the need for optimal use of state financial resources, the problem of strengthening the targeting of social support for families with children is of particular relevance [4, p. 529], which is especially important in the framework of a responsible budget policy in the

social sphere [2, p. 65] and the implementation of national projects [3, p. 128].
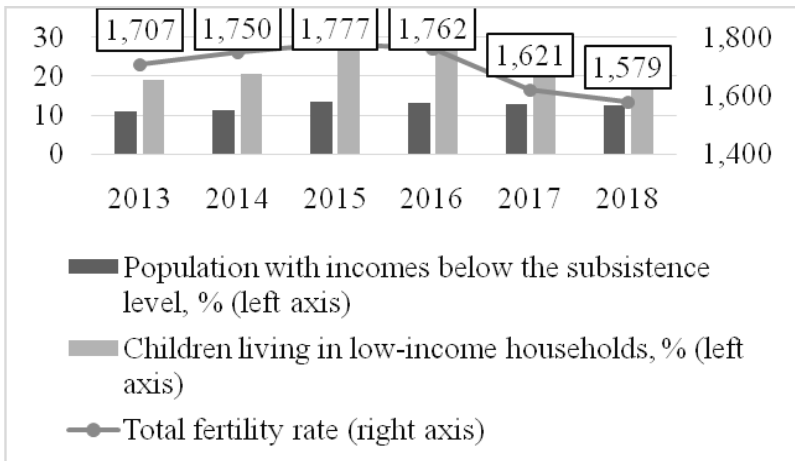
Figure 1. The birth rate and poverty rate of the Russian population in 2013-2018. Source: Compiled by the author based on data from the Federal State Statistics Service [5].

The problems that determine the ineffectiveness of social support measuresin terms of ensuring their targeting are combined by the author into two blocks:methodological and implementation.

The block of methodological problems contains three main shortcomings of the Russian legislation, the reliance on which in building a system of socialsupport for families with children does not allow for the solution of these quantitative and qualitative problems but contributes to the "freezing" of negativephenomena in the social sphere, exclusively preventing the deterioration of the situation.

First, the Russian legislation establishes too broad aninterpretation of the concept of "child". Representatives of this age group are all persons under the age of 18. Without disputing the possible convenience of such allocation for other areas of public administration, we note that in the context ofproviding social support measures, it is not appropriate, sinceits application equalizes the needs of significantly differentgroups of children: for example, a new-born child seriously differs in itsbiopsychosocial and consumer characteristics from a pre-schooler,and that, in turn, is very different from the child of adolescence.

Secondly, when analysing the existing measures of social support for families with children in Russia, it is difficult to clearly determine the object of thissupport[1, p. 20]. It is worth noting that the concepts of "child support" and "support fora family with a child (children)" appear to the author to be fundamentally different.In the first case (more typical for Russia), the child is considered asa separate family member. The disadvantage of this approach is that the funds paid for the child, however, go to the family disposal. Thus, there is a high probability that the funds will be spent not on the child, but on other family needs (worse spent withoutbenefit). At the same time, it is worth noting that in a situation where the amount of funds is nottoo large, there is a high probability that in the end it will not be possible to meet either thefamily needs or the needs of the child.

Third, the Russian legislation is characterized by absolutedefinition of poverty – a state in which a person's income is below a certain value (the subsistence minimum). Such a definition places a serious responsibility on the State for shaping the characteristics of income and consumptionconditions that determine a person's poverty. And althoughit is possible to use this approach, within the framework of Russian practice, this concept takes an extremely inflexible form.

The block of implementation problems is associated with the imperfectionof the targeting tools used in Russia and is a direct consequence ofthe above-mentioned methodological errors.

First, it is worth noting the small number of targeting tools used in Russia. In fact, the need for support is determined only with the help of the consumer basket (as a source for calculating thesubsistence minimum).

Secondly, an important problem is the inefficiency of the methodology for calculating the child's subsistence minimum. The current methodology is entirely based on thenormative food basket, which is the basis for determining the cost of a minimum set of non-food goods and services and does not consider the actual structure of consumption in the country.

Third, when establishing social support measures for differentgroups of children, different criteria of need are applied, which can be either two-fold (monthly allowance for the birth/adoption of thefirst child), or a single amount of the subsistence minimum (payment for children from 3 to 7 years). Such inconsistency in the establishmentof the targeting criterion leads to an increase in the asymmetry of the standard of living of children in needin different groups.

Based on the above, the author suggests the following stepsmodernization of the system of social support for families with children:

1. It is necessary to establish by law the periodization of childhood, compiled considering the achievements of medical, sociological, economic, and other sciences. The tools used to assess targeting and provide social support should be differentiated considering thisperiodization.

2. It is necessary to clearly define that the object of social support is the family, as an indivisible unit of society. This concept requires the establishment of a few tools that analyse the aggregate status of all family members (for example, the use of a living wage in the modern version in this approach is incorrect because it defines the poverty line characterizes the state of an individual, not of the group of persons).

3. All the instruments of implementation of social support should beformed with the objective of socio-economic processes,what is happening in society. It is supposed to abandon the normative method,which imposes an element of subjectivity in the assessment of poverty in favour of the method of statistical justification of support measures.

Consistent implementation of the proposed steps will allow us to modernize the methodological basis of social support for families with childrenin the Russian Federation and, thereby, create an opportunity to determineobjective criteria for its targeting.

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Аннотация. В статье автором обоснована актуальность функционирования системы адресной поддержки семей с детьми. Выделено два укрупненных блока существующих в ней проблем: методологический, связанный с несовершенством законодательства, и инструментальный. В рамках анализа каждого из укрупненных блоков выделены основные недостатки существующей системы поддержки.

Предложены направления модернизации концептуальной основы поддержки семей с детьми в Российской Федерации, а также описаны соответствующие ей инструменты.

Ключевые слова: семьи с детьми; социальная поддержка; адресность социальной поддержки; критерий нуждаемости; прожиточный минимум.

Annotation. In the article, the author substantiates the relevance of the functioning of the system of targeted support for families with children. There are two enlarged blocks of existing problems in it: methodological, related to the imperfection of legislation, and instrumental. As part of the analysis of each of the enlarged blocks, the main shortcomings of the existing support system are highlighted. The directions of modernization of the conceptual framework for supporting families with children in the Russian Federation are proposed, and the corresponding tools are described.

Keywords: families with children; social support; targeted social support; the criterion of need; the cost of living.

SECTION 6: PHYSICS, BIOLOGY, ASTRONOMY AND ECOLOGICAL PROBLEMS

UDC 537.8

PRACTICAL APPLICATION OF ELECTROMAGNETIC INDUCTION IN VARIOUS FIELDS OF SCIENCE AND TECHNOLOGY

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To date, physics has reached heights in its development. Thanks to the research conducted in this area, our country is successfully developing scientific, technical and industrial complexes. That is why the relevance of studying physics does not fade with time.

Special attention in the study of this field of knowledge is given to the section "Electrodynamics". At the moment, it is impossible to imagine the functioning of any area without the information obtained as a result of research in this area. Electrodynamics deals with the study of the electromagnetic field and the interaction between electric charges. It also considers the use of electrical and electromagnetic phenomena in various fields: in science, technology, industry, and everyday life. This article is devoted to the practical application of electromagnetic induction.

In 1831, Michael Faraday established that inside a closed conducting circuit, when the magnetic field changes, an electric current arises, which later became known as an induction current. As a result of a number of experiments, he discovered the phenomenon of electromagnetic induction [1, p. 187].

Electromagnetic induction is a phenomenon in which a current occurs in a closed conductor when a magnetic field passes through it, which changes with time. Let's look at where it finds its application.

Very often, the phenomenon of electromagnetic induction is used in radio broadcasting. An alternating magnetic field generates an electric field due to changing currents. Subsequently, these fields are able to form a single electromagnetic field and propagate at the speed of light - 300,000 km/s.

The phenomenon of electromagnetic induction is also actively used in telecommunications systems. The main structural elements in the maintenance of cellular communication are stations and mobile radiotelephone devices. These stations provide support with mobile devices, after which they act as sources of the electromagnetic field. This system is based on the principle of dividing the coverage area into small zones, which are called "cells", their radius can be up to 10 km.

Since computers operate at the expense of electric current, therefore, they are sources of an electromagnetic field, which has complex spectral and wave compositions. It includes magnetic, electrostatic and radiation components. Note that personal computers are widely used in various fields of human activity and have a negative impact on their health.

This phenomenon is also used in magnetic therapy. A special role is given to the use of X-rays and electromagnetic radiation. They are usually characterized by continuously connected magnetic and electric fields.

Much attention is paid to the phenomenon of electromagnetic induction when creating a synchrophasotron (charged particle accelerator). At the present stage of the development of electrodynamics, a magnetic field is understood as a special type of matter that consists of charged particles. These beams of charged particles are used to penetrate deep into the atoms. This need arises as a result of research. Note that a charged particle is affected by a force called the Lorentz force [2, p. 98].

The action of DC generators is not complete without the phenomenon of electromagnetic induction. In the mode of their operation, under the influence of an external moment, the anchor of the machine comes into rotation. The magnetic flux located between the poles of the starter, penetrating the armature. In turn, the winding conductors enter the magnetic field and as a result, the EMF is induced. Note that its direction is determined by the "right hand" rule. Moreover, on one of the brushes there is a positive potential relative to the other. When the load is connected to the generator terminals, an electric current begins to flow [1, p. 204].

A transformer is a static device that consists of two or more inductively coupled windings. Thanks to such a device, it becomes possible

to convert some AC systems into others using the phenomenon of electromagnetic induction. Transformers are widely used in power supply, show industry, radio broadcasting and other areas. Thanks to the use of this device, it becomes possible to solve the following tasks: changing the number of phases, increasing (lowering) the voltage, matching loads, etc. As a result, all conversions are performed with minimal power consumption, as well as without changing the frequency.

Thus, we conclude that such a phenomenon as electromagnetic induction finds its application in many areas of industry, science and technology. The problem of converting mechanical energy into electric current energy is used by devices such as synchronous generators. To change the voltage limits, transformers are used, which makes it possible to economically transfer electrical energy from power stations to a specific source of consumption.

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Аннотация. Развитие науки и техники в наше время происходит очень стремительно. Это необходимо всему человечеству. Создаются различные приборы и аппараты, принципы работы которых основываются на обычных физических явлениях. В данной статье рассмотрим, как и в каких областях применяется явление электромагнитной индукции.Электромагнитная индукция — явление возникновения электрического тока, электрического поля или электрической поляризации при изменении магнитного поля во времени или при движении материальной среды в магнитном поле. В статье рассматриваются примеры использования этого явления, которое известно каждому школьнику.

Ключевые слова: электродинамика, применение, электромагнитная индукция, электрический ток, развитие.

Annotation. The development of science and technology in our time is very rapid. Various devices and apparatuses are created, the principles of which are based on ordinary physical phenomena. In this article, we will consider how and in what areas the phenomenon of electromagnetic induction is applied. Electromagnetic induction is the phenomenon of the occurrence of an electric current, electric field, or electric polarization when the magnetic field changes over time or when a material medium moves in a magnetic field. The article discusses examples of the use of this phenomenon, which is known to every schoolchild.

UDC 535.3

ATMOSPHERIC OPTICAL PHENOMENA CAUSED BY REFRACTION IN THE AIR

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The Earth's atmosphere is the gas envelope of our planet, extending thousands of kilometers above the surface and having a multi-layered structure. Looking ahead, we can note that it is thanks to the Earth's atmosphere and its heterogeneous structure that we can observe interesting phenomena, which will be discussed below.

For the rays that come from the sun and other celestial objects, atmosphere it is a specific optical system in which the parameters tend to change. The atmosphere in the path of those rays, reflects, passes, and also scatters some of the light to provide illumination to the earth's surface. The other effect manifests itself under certain conditions, when the light in the spectrum is decomposed into its components. All of the above causes various atmospheric phenomena.

Now we will consider the most frequently asked question, which will help to further justify the course of rays in the atmosphere: "Why is the sky blue?"

Air, by its nature, scatters short-wave light faster than long-wave radiation. Given the intensity of Rayleigh scattering, which is based on fluctuations in the number of gas molecules in the air, violet radiation is scattered more intensively by about 16 times than red, as violet radiation has a shorter wave. Therefore outside the direction of the Sun the sky has a blue shade [2].

The time of sunrise and sunset falls at the moment when the sun's rays pass, barely touching (tangentially) the surface of the earth. Therefore, the path traversed by light in the atmosphere increases in comparison to the way that it passes during the day. The redness of clouds in the sky near the horizon is explained by the fact that most of the green and blue light is scattered to the sides from direct sunlight.

Also, it should be noted that during sunrise and sunset, when the solar disk touches the horizon with the lower edge, we see it only due to refraction (the deviation of the light wave from a straight line). In its absence, no part of the solar disk would be visible above the horizon as the refraction slightly exceeds the apparent angular diameter of the Sun [3]. Watching the beginning of the sunrise, no one realizes that in fact the Sun itself has not yet reached the horizon. This is the whole strangeness of the most ordinary phenomenon. Let's take a closer look.

Atmospheric refraction occurs due to changes in the density of the air as a function of altitude. This refraction is due to the speed of light through the air, which decreases (the refractive index increases) with increasing density [1].

Picture 1 – Atmospheric refraction

Whenever possible, astronomers plan their observations around the time of the climax, when the celestial objects are at their zenith. For exactly the same reason, sailors will not follow a star below 20° above the horizon.

Since the amount of atmospheric refraction is a function of the temperature gradient, it is therefore the main cause of mirages-a displaced image of distant objects or the sky.

In general, the mirage does not depend on how hot the air is, rather, it is all about the temperature difference between the air directly above the earth's surface and the air that goes above. Lower mirages can also be easily observed on clear winter days, or on a slate roof, or over a grill-wherever a sharp change in temperature makes the air light and pulsating. These everyday mirages, so mundane and familiar that we barely notice them.

A) Upper Mirage
B) Lower Mirage

Picture 2 – Upper and lower Mirages

Unlike a hallucination, a mirage is a real optical phenomenon that can be captured on camera, as the rays of light are actually refracted to form a false image at the observer's location.

It should be noted that atmospheric refraction becomes stronger when both the temperature gradients are strong, and the refraction is inhomogeneous, as the atmosphere is inhomogeneous. This leads to suboptimal vision conditions, and there is such a phenomenon as the twinkling of stars.

In simple terms, the twinkling of stars is caused by the passage of light through various layers of the turbulent atmosphere. Most flicker effects are caused by abnormal atmospheric refraction caused by small-scale fluctuations in air density, usually associated with temperature gradients.

Flicker effects are always much more pronounced near the horizon than near the zenith (overhead), as light rays near the horizon must penetrate a denser layer and have longer paths through the atmosphere before reaching the observer. The flicker frequency ranges from one hertz to hundreds of hertz. Also, near the horizon, a typical color flicker - a change color of the star.

Although light from stars and other astronomical objects is likely to flicker, however the planets do not flicker. Why?

The stars twinkle because they are far from Earth and appear to be point sources of light, easily disturbed by the Earth's atmospheric turbulence, which acts as a special optical system that deflects the path of light. Planets are not prone to flickering. The angular size of planetary disks, although not distinguishable to the naked eye, but is much larger than that of distant stars: the latter look like dots even in the most powerful astronomical instruments. And if there are several observed points of light crossing the atmosphere, the deviations of their light are averaged, and the observer perceives less variability in the light coming from them.

The total number of optical phenomena in the atmosphere is very large. Here we have considered only the most well-known phenomena, the formation of which is associated with the refraction of light. There are also phenomena that are explained by the reflection of light, or by the wave properties of light-dispersion, interference, diffraction, polarization, or by the quantum properties of light.

It is amazing, because even in the 19th century, mirages terrified sailors, and astronomers made mistakes in their observations. However, today, everyone who knows the laws of optics can rule out incorrect conclusions and explain many mysterious, beautiful and interesting natural phenomena.

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3. Сивухин Д.В. Общий курс физики: Оптика, т.4. – Москва: «Наука», 1980. – 752 с.

Аннотация. Общее число оптических явлений очень велико. В данной работе рассмотрены лишь наиболее известные оптические явления в атмосфере, образование которых связано с преломлением света. А именно, атмосферная рефракция, миражи и мерцание. Земная атмосфера рассмотрена как сложная оптическая система, на основе этого изложены причины возникновения вышеупомянутых явлений. Также объяснены вопросы «Как отличить звезду от планеты», «Почему не стоит ориентироваться на звезду вблизи горизонта», которые можно применить во избежание ошибок в научной деятельности.

Ключевые слова: оптические явления, атмосфера, преломление света, рефракция, миражи, мерцание.

Annotation. The total number of optical phenomena is very large. This article discusses the most well-known optical phenomena in the atmosphere, caused by refraction in the air. For example: atmospheric refraction, mirages and flickering. The Earth's atmosphere is considered as a complex optical system. Based on this fact, the reasons for the occurrence of the above-mentioned phenomena are described. It also explains the questions, which can be applied to avoid mistakes in scientific activity. For example: "How to distinguish a star from a planet","Why not focus on a star near the horizon".

Keywords: optical phenomena, atmosphere, light refraction, mirages, flickering.

WATER QUALITY IN CENTRALIZED WATER SUPPLY SYSTEMS (CAMPUS OF TOMSK POLYTECHNIC UNIVERSITY)

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Introduction

It is common knowledge that any water used for domestic use must be treated. Water sources, pipelines and a number of other factors have their own characteristics that affect water composition differently. Therefore, there are various impurities in the water [8].

One of the most important factors in maintaining the sanitary and epidemiological well-being of the Tomsk region is the provision of potable water to population that meets the sanitary and epidemiological requirements in terms of quality and safety indicators. For the past 45 years, underground water supply has dominated in Tomsk, as it is safer nowadays [2].

The purpose of this work

- to analyze statistics on water supply in Tomsk;
- to analyze the views of campus residents on piped water in dormitories.

Statistics

After a search through the scientific literature, the following facts can be highlighted:

- In 2018, the Tomsk region was the last in the ranking in terms of drinking water quality in the regions of the country [7].
- The main source of water supply is underground water from artesian wells. They are protected from surface contamination and have a stable composition. Microbiological indicators of underground waters correspond to the established hygienic standards [6].
- According to chemical standards, there is an increased content of iron, manganese and silicon in the water [1].

The research method

A survey of the residents of the campus about the quality of pipeline water was conducted. The survey involved 100 students as respondents, they answered the following questions:

1. How do you assess the quality of pipeline water in general?
2. Have you encountered any water-related problems after moving to Tomsk?
3. Do you filter water or buy bottled water?

According to all the survey results, it was found that:

- About 50% of foreign students had an unfavorable reaction of their body to the use of Tomsk water.
- Most respondents use water filters or bottled water.
- The respondents' opinion on water quality is shown in the diagram:

HOW DO YOU ASSESS THE WATER QUALITY ON THE TPU CAMPUS?

- Completely satisfied 7%
- Rather satisfied 11%
- Rather not satisfied 39%
- Completely not satisfied 14%
- I don't care 29%
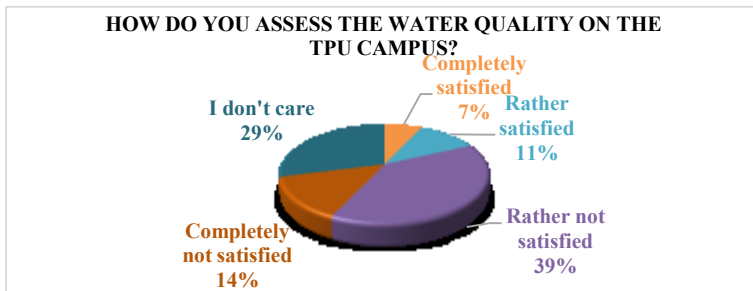
Conclusion

Summing up, we can conclude that the water quality is satisfied with a fairly small number of respondents [4]. The studied information also showed that there are many problems with the central water supply of Tomsk [4]. However, Tomsk region government is taking certain measures to improve the water quality of this region. Currently, the Clean Water project has been restored [5].

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8. Water Treatment Solutions. Available at: http://www.lenntech.com/applications/drinking/faq/drinking-water-faq.htm. (дата обращения: 8.04.2021).

Аннотация. Работа посвящена изучению качества водопроводной воды г. Томска в студенческих общежитиях Томского политехнического университета (ТПУ). Авторы исследовали основную общедоступную информацию о системе центрального водоснабжения Томска. Кроме того, авторы изучили мнение студентов, проживающих в общежитиях, о качестве воды. Результаты исследования показали, что не все студенты довольны качеством местного водоснабжения.

Ключевые слова: водоснабжение, качество воды, питьевая вода, водопроводная вода, подземные воды, водопроводная вода.

Annotation. This work is devoted to the study of pipeline water quality in Tomsk in the student dormitories of Tomsk Polytechnic University (TPU). The authors investigated the basic publicly available information about Tomsk central water supply system. In addition, the authors have studied the opinion of university students living in dormitories, on water quality. The findings of the study showed that not all students are satisfied with the quality of local water supply.

Keywords: water supply, water quality, drinking water, piped water, underground water, pipeline water.

UDC 52-424

THE EARTH AND MOON FORMED LATER THAN PREVIOUSLY THOUGHT

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The Earth and Moon were created as the giant collision result between planets with the size of Mars and Venus (pict. 1). It was supposed that it have happened when the solar system was 30 million years old or about 4,537 million years ago. But new research of Niels Bohr Institute shows that the Earth and Moon have formed much later, perhaps up to 150 million years after the solar system formation. The scientific journal, "Earth and Planetary Science Letters" have published the research results (picture 2).
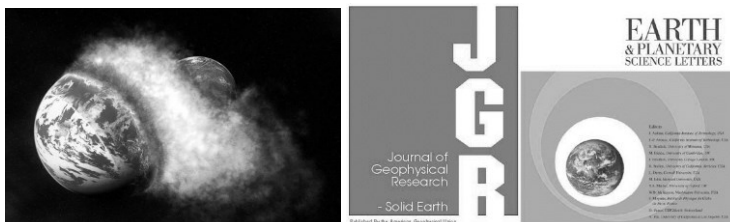
Picture 1 – The giant collision   Picture 2 –Scientific edition

Tais W. Dahl did the research at the Niels Bohr Institute at the University, Copenhagen (picture 3). The ages of the Earth and the Moon were determined "using tungsten isotopes, which can reveal whether the iron cores and their stone surfaces have been mixed together during the collision" [2, p.241].

Picture 3 – Tungsten isotopes

The planets were created by collisions in the Solar system between small dwarf planets orbiting the newborn sun. The small planets melted together and formed larger and larger planets there. The Earth and Moon are the gigantic collision result between two planets of the size of Mars and Venus. They collided at a time when both had a core of metal (iron) and a surrounding mantle of silicates (rock). "The collision took place in less than 24 hours and the temperature of the Earth was so high (7000º C), that both

rock and metal must have melted in the turbulent collision. But were the stone mass and iron mass also mixed together?" [1, p. 125].

It was believed that the rock and iron mixed completely during the planet formation until recently. The conclusion was made that the Moon was formed when the solar system was 30 million years old or approximately 4,537 million years ago. But new research shows completely different data.
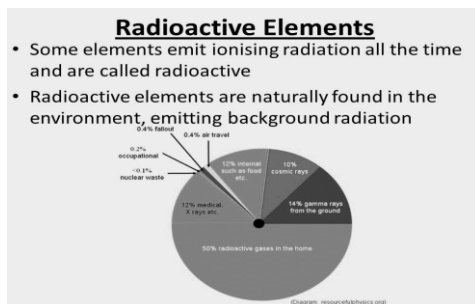
Picture 4 – Dating with radioactive elements

The age of the Earth and Moon is dated by examining the presence of certain elements in the Earth's mantle. Hafnium-182 is a radioactive substance. It decays and is converted into the isotope tungsten-182. The two elements have different chemical properties. While the tungsten isotopes bond with metal, hafnium ones bond to silicates, i.e. rock.

"It takes 50-60 million years for all hafnium to decay and be converted into tungsten, and during the Moon forming collision nearly all the metal sank into the Earth's core. But did all the tungsten go into the core?" [3, p. 55].

The researchers found that tungsten isotopes from the Earth's early formation remain in the rocky mantle. The moon forming collision occurred after all of the hafnium had decayed into tungsten completely.

And metal core and rock emulsified in collisions between planets that are greater than 10 kilometres in diameter. Most of "the Earth's iron core (80-99 %) did not remove tungsten from the rocky material in the mantle during formation" [3, p. 54].

Conclusion. The researches proved that the Earth and the Moon must have been formed much later than previously thought. It is not 30 million years after the formation of the solar system but up to 150 million years after the Solar system formation.

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Аннотация: Статья посвящена изучению времени возникновения Земли и Луны. Использование изотопов вольфрама позволило определить возраст этих планет, которые,по всей видимости, сформировались намного позже предполагаемого ранее времени их возникновения.

Ключевые слова: Земля, Луна, изотоп, столкновение гигантов, Солнечная система.

Annotation. The article is devoted to the study of the origin of the Earth and the Moon. The tungsten isotopes usage allowed to determine the age of these planets which probably formed much later, than previously thought.

Keywords: the Earth, the Moon, isotope, giant collision, Solar system.

UDC 502.2

DEVELOPMENT OF GEOTHERMAL ENERGY ON THE EXAMPLE OF THE TOMSK REGION

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Introduction

The incessant growth of energy consumption, the reduction of hydrocarbon reserves, the increase in prices for organic fuel and its transportation to remote regions of Russia make people think more and more about the active use of renewable energy sources. Geothermal energy is considered one of the most promising areas in this area.

The purpose of this work: to explore a more profitable and environmentally friendly energy source to existing ones.

The research method

The author studied the theoretical material on the theme of geothermal energy and answered the following questions:

1) Is this direction promising?

2) What is it based on?

3) The benefits of geothermal energy.

4) Are there geothermal power plants in Russia?

5) Installation of geothermal power plants in the Tomsk region.

Geothermal energy

Geothermal energy is under the earth. Geothermal energy is a renewable energy source because heat is continuously produced inside the earth [2].

Geothermal energy is based on the production and sale of heat and electrical energy at the expense of thermal energy, which is contained in the bowels of the earth.

Advantages of geothermal energy:

1. Arenewable resource. Unlike modern heat sources, no fuel is required to generate geothermal energy.

2. Inexhaustibility and efficiency (coefficient of utilization of installed capacity - 80%)

3. Independence of environmental conditions and time of year.

4. The construction of a geothermal plant does not require large areas.Environmental pollution will be kept to a minimum.

Geothermal energy is energy in the form of heat accumulated below the surface of the "solid" Earth. In 1 liter of the "inner space" of the Earth, an average of 2.6 kW of energy is accumulated. Due to the heat capacity of the Earth, people could meet the current world energy needs for 30 million years. The formation of geothermal energy occurs due to the decay of radioactive substances in the earth's crust and mantle. The average temperature of the Earth at a depth of 3-5 m throughout the year is 10-13 °C and higher. This is sufficient for the normal use of geothermal energy resources.

Today 58 countries use the heat of their geothermal resources not only for electricity production, but directly in the form of heat: for heating baths and swimming pools – 42%; for heating – 23%; for heat pumps – 12%; for heating greenhouses – 9%; for heating water in fisheries – 6%; in industry – 5%; for other purposes – 2%; for drying agricultural products, snow melting and air conditioning – 1% [3].

Geothermal energy in Russia

Currently, Russia operates three geothermal power plants located in the Kamchatka Territory [1]. According to modern estimates, the potential of geothermal energy in Russia significantly exceeds the reserves of organic

fuel (up to 10-15 times). Active thermal waters in Russia are common in several regions: in Buryatia, Chukotka, Yakutia and West Siberia.

Geothermal energy in Tomsk region

Deep underground in the Tomsk region is a large amount of geothermal energy resources — about 70 % of the total Russian reserves are concentrated in West Siberia. already about 200 objects in the territory of Tomsk and the Tomsk region have switched to the geothermal heating system.

In the Tomsk region, it is possible to install geothermal power plants in the village of Chazhemto and the village of Lukashkin Yar. 12 geothermal power plants (from 1 to 3 power units each) with a total capacity of 12 MW [3].

One of the most famous examples is the kindergarten "Solnechnyjzajchik" and the school in the village of Vershinino. The heat needs of these institutions are already being met through the use of geothermal energy [5].

However, there are a number of difficulties that the owners of the equipment will have to face. The cost of heat pumps is about one hundred thousand rubles, the process of installing them is laborious, and the heat output is low. Therefore, heat pumps can become the main, but not the only, source of heat. Such equipment pays off in four to five years.

Consequences

Thus, author found that geothermal energy is a very efficient energy source among others, due to its environmental friendliness, economy and energy volume. It should be expected that the introduction of a geothermal power plant in the Tomsk region will significantly improve the environmental situation and allow consumers to reduce energy costs.

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Аннотация. Данная работа посвящена изучению геотермальной энергетики в Сибири и установке геотермальных станций в Томской области.

Автор рассматривает перспективы этого направления, его преимущества и возможности для развития в Сибири.

Ключевые слова: геотермальная энергия, геотермальная электростанция, органическое топливо, возобновляемые источники энергии, активные термальные воды.

Annotation. This work is devoted to the study of geothermal energy in Siberia and the installation of geothermal stations in the Tomsk region.

Theauthor considers the prospects of this direction, it is advantages and opportunities for development in Siberia.

Keywords: geothermal energy, geothermal power plant, organic fuel, renewable energy sources, active thermal waters.

BIOFUEL AS A PROMISING ENERGY SOURCE

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For a long time in the world there has been a problem of lack of energy resources. Due to the struggle for fuel, as one of the factors influencing the direction of development of international relations, in recent years this issue has become more intense [1].

Energy sources include: oil, gas, coal, etc. However, when using such energy resources, the issue of safety and disposal of spent fuel arises. Serious concerns are voiced about the correlation between the state of the planet and the use of conventional fuels. Also, every year there is an increase in demand for fuel supplies. But, given the fact that resources on the planet are limited, there is a constant increase in prices on the world market (for example, for oil and gas).

In such a situation, attempts are made to use various methods of generating energy using non-traditional (alternative) and renewable energy

sources. One of the advantages of non-traditional energy resources is the reduction in prices due to the rapid development of technologies in recent years. Biofuel (biofuel) is one of the alternative energy sources [3].

Biofuels are based on biomass (a product of photosynthesis). It is the most powerful solar energy converter on the planet and the subsequent diverse food chain, the main source of fuels and energy.

In essence, any energy source that needs to be burned is biofuel. But in the case of minerals such as coal, oil or gas, biomass has come an extremely long way of being converted into energy. Modern humanity cannot wait that long, so scientists are trying to speed up this process, or at least radically change it [2].

As shown in pic. 1, the production of electricity from alternative sources and, in particular, bioenergy products continues to grow every year, contributing to meeting the growing energy needs in a number of countries, as well as achieving environmental goals. However, bioenergy still faces a number of challenges, such as declining oil prices and political instability in some markets. The use of electricity generated from biomass is growing faster - an average of 8% per year - with a particularly rapid pace in China and Europe. Ethanol production is increased by 4% globally. Record rates are observed in the United States. Biofuel composition mandates (conventional and renewable) have maintained biofuel demand amid falling oil prices, but market uncertainty is still holding investors back from investing in biofuels. Biofuel mandates have protected biofuel demand from falling pricesfor fossil fuel, but uncertainty remainsconcerning caps on investment in new production facilities during the year. In 2016, progress continues in the development of new generation biofuels with an increase in the capacity and volumes of fuel production by thermal and biological methods. Scientific studies as,for example, the effect of biomass burnout on the efficiency of the released energy,are being conducted. So is the development of new methods for producing biofuels, for example, from raw materials waste, forestry and agriculture [4].
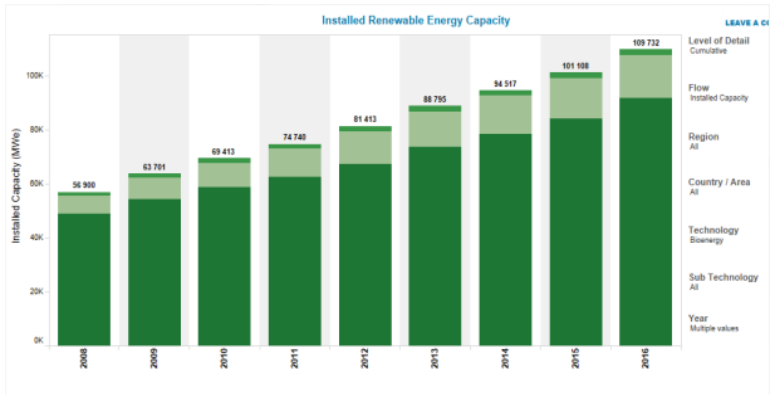
Pic. 1 – Installed total capacity of renewable energy (bioenergy) in the world, MW.

Biofuels are subdivided into solid, liquid and gaseous. Solid wood is traditional firewood (often in the form of woodworking waste) and fuel pellets (pressed small woodworking residues).

Liquid fuels are alcohols (methanol, ethanol, butanol), ethers, biodiesel and biomass oil.

Gaseous fuel comprises various gas mixtures with carbon monoxide, methane, hydrogen obtained by thermal decomposition of raw materials in the presence of oxygen (gasification), without oxygen (pyrolysis) or by fermentation under the influence of bacteria [5].

Therefore, the goal is to completely move away from photosynthesis. Presumably, this will be a device that absorbs carbon dioxide and water vapor from the air, and using solar energy, converts these substances into hydrocarbon fuel. A very unrealistic task, as it may seem, but serious funding for these developments is already being allocated by the US Department of Defense. The reason is that the fuel delivery for its troops to some regions of Afghanistan raises its price up to $300per literat the most remote bases.The fact that about 70% of losses in equipment and manpower are noted precisely during attacks on fuel convoys and detonation of convoys, should also be taken to account [2].

On average, the global biofuel production is now increasing by 7-8% per year. Russia is one of the three leading exporters of biofuels. But unfortunately, these are just pellets that are made from logging waste. As for the rest of the world, the European Union, the USA, the countries of South America and Southeast Asia, at almost every gas station, one can fill a fuel tank with bio-gasoline or ethanol, or a 100% mixture of hydrocarbons obtained from alternative sources.

Alternative energy sources, in particular biofuels, have secured the status of a competitive energy source in both developed and developing countries. This was primarily due to the growing price competitiveness of technologies using renewable energy sources and biofuels, alsodue to political initiatives, the need to solve energy and environmental security problems, the growing energy needsof the developing and young economies, and the need to make modern energy affordable [1].

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Аннотация. В статье затрагивается как вопрос экологии на планете в целом, так и конкретно один из путей улучшения её состояния – развитие биотоплива как источника энергии. Приводится статистика развития данной отрасли в науке за последние годы, рассматриваются виды биотоплива, а также способы развития биотопливной промышленности.

Ключевые слова: биотопливо, энергия, ресурс, топливо, фотосинтез, производство.

Annotation. The article touches on both the issue of ecology on the planet as a whole, and specifically one of the ways to improve its condition development of biofuel as an energy source. The statistics of the development of this branch in science in recent years are given, the types of biofuels are considered, as well as the ways of development of the biofuel industry.

Keywords: biofuel, energy, resource, fuel, photosynthesis, production.

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ENVIRONMENTAL PROBLEMS IN PRODUCTION

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Nowadays, environmental preservation is an important spectrum to pay attention to. People around the world are trying to treat nature with care, because, seeing a huge number of environmental problems, it is difficult to remain indifferent. It's not a secret for anyone that we have only one Earth and it is impossible to return everything to its original state just snap our fingers. Therefore, all we can do is maintain a clean environment, take care of ourselves and those around us, control the processes of modern technologies, which, simplifying our life, have a detrimental effect on the state of our planet. And our goal is to minimize the negative impact on the natural component of our world.

Environmental innovation is innovation related to technology and social culture, which is responsible for the rational use of natural resources in production and for changing the attitude of people towards wrecking their own planet. Introducing people to new habits, correct orientation in the modern world.

Environmental innovations, as mentioned above, are divided into 2 types:

The first type is based on the correct consumption and use of the most environmentally friendly production methods, the use of the minimum amount of energy and natural resources, while obtaining the maximum possible, and most importantly, the desired product, which will be fully consumed by the population. Product quality control and reduction of emissions into the atmosphere, which also has a detrimental effect on the state of nature.

Previously, various kinds of technologies were not available to mankind, and the main goal of production was aimed at obtaining the maximum amount of products with less money in a minimum amount of time because it was profitable to produce and introduce something new. Now humanity has reached the state when the level of quantity - quality cannot do without consequences. It is important to take into account exactly how much damage this will cause to nature, how important it is for mankind to receive this product, and what a person can sacrifice by starting such a production.

The second type includes everyday human consumption of products. If earlier we considered exactly the attitude of factory production, then here it is important to say about reasonable consumption and the correct attitude towards waste. A person must monitor the use of a particular product and choose the most appropriate and environmentally correct consumption methods. It is important to remember about the emissions into the atmosphere that occurs due to the wrong attitude towards your planet, which is caused by ignorance and lack of responsibility. People do not think that besides them there are billions of people on the planet, and over the years there will be other generations that will also live on this planet and use those resources that may end soon. The death of nature, the death of animals, fires in forests, and the drying up of water bodies are only a small part of the harm that a person causes to nature with emissions.

Now, in order to avoid serious environmental problems, production methods are being developed in the world that causes minimal harm to the environment.

Such techniques are used in various areas of production. For example, the production of clothing is currently considered one of the advanced areas, because people are increasingly beginning to strive for convenience, and often convenience is a sign of quality, and quality, as we all know, in the textile industry is natural fabrics. The production of sustainable clothing contributes to the minimum negative impact on the environment. After all, the use of synthetic fabrics adversely affects the air due to the release of toxins during production, and further decomposition of synthetics only emits a vapor that harms the soil and the composition of the earth's crust, that is, it decomposes minimally, causing harm to the environment [1].

If we consider chemical production, then now chemists are trying to abandon the use of harmful chemicals in order to avoid the subsequent negative impact on human health and on the state of the atmosphere [2].

It is important to remember that the interaction between man and nature is not one direct; human is also affected by bad treatment of the environment. Thus, a vicious circle is obtained, where the harm caused to a person also depends on a person.

Humanity has several ways of further development: the first is a complete rejection of the impact on the environment, which will lead to a fall in the economy and high costs in production, almost all production will stop working, which will lead to a crisis and degradation. The second way is to continue production without thinking about the further state of nature, however, as mentioned above, this will lead to the death of mankind. In this case, there is only one option - to combine production with the maintenance of the environment, while reducing the carbon footprint. However, it is

worth considering the state of the entire planet, and not of a particular state, because if forests die on one continent, harm will be done to the planet. Humanity lives in one large ecosystem, where everything is interconnected, and therefore it is important to maintain the state of the planet as a whole.

Next, we will consider the global environmental problems that can be avoided by transforming production towards environmental protection.

Due to deforestation and the killing of animals for food production and livelihoods, there is a decrease in the wealth of nature, the death of biological species. Due to the introduction of hazardous chemicals into the ground, soil conditions are deteriorating. The state of the atmosphere is deteriorating due to the release of methane and carbon dioxide, and the ozone layer is disrupted. It is important to say about global warming, which may threaten our planet in the near future if humanity does not start doing something.

When we only look at the emissions produced today, we are not aware of the historical responsibility for emissions in recent decades or centuries.

People around the world are increasingly concerned about climate change: 8 out of 10 people think climate change is a serious threat to their country (Pew Research Center 2018 study). Food production is responsible for a quarter of the world's greenhouse gas emissions. There is a growing awareness that our diet and food choices have a significant impact on our carbon footprint. But it's also important to talk about emissions. It's not even about the plastic that floods our planet every day, it's about food. As mentioned earlier, people follow fresh and quality meat, and therefore emissions of animal carcasses and nutrients occur. The production of each product releases parts of the fertilizer or manure into water bodies through untreated wastewater. These are good nutrients for organisms within water bodies. But when too many nutrients are formed in the water system, their balance is disturbed - this is called eutrophication. Aquatic plants grow rapidly, feeding on fluoride and nitrogen from agricultural wastewater. When overgrown aquatic plants decompose, they consume oxygen and can release toxins – this is how all life in the reservoir dies, up to fish and ecosystems surrounding the water.

There are many organizations that monitor emissions and the state of nature, such as the UN, the International Union for Conservation of Nature and Natural Resources, UNEP, WWF, and so on.

At the moment, the world needs to maintain the right balance of impact on the environment with what a person takes from it.

Thus, the introduction of environmental innovations is something that can help humanity, prolong life and preserve the state of nature.

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Аннотация. В наше время важно не только самостоятельно сохранять окружающую среду, но и помнить о производстве, которое наносит огромный вред экологии планеты.В этой статье объясняется, что такое экологические инновации и то, на какие группы они делятся. Также то, почему важно придерживаться этих групп и почему это полезно для человечества. В статье рассказывается о том, что случится с миром, если люди не будут сохранять окружающую среду чистой и продолжат продвигать производство, которое плохо влияет на природу. В этой работе исследуются экологические проблемы человечества и их зависимость от производства. Это показывает, почему важно помнить об окружающей среде.

Ключевые слова: экологические инновации, производство, экология, загрязнение, вред, глобальное потепление, смерть человечества.

Annotation. Nowadays, it is important not only to preserve the environment on our own, but also to remember about production, which causes enormous harm to the planet's ecology. This article explains what environmental innovation is and what groups they fall into. Also, why it is important to adhere to these groups and why it is beneficial for humanity. The article tells about what will happen to the world if you do not save the environment, pollute the atmosphere and continue to promote production that has a bad effect on nature. This work examines the environmental problems of mankind and their dependence on production. It shows why it is important to keep the environment in mind.

Key words: Environmental innovation, production, ecology, pollution, harm, global warming, death of humanity

ALTERNATIVE ENERGY OPTIONS FOR SHIPPING

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Introduction. All modern power engineering is based on the conversion of liquid water into steam and this will last for a long time, but there are already a large number of developments in the generation and algorithms for use for energy. The problem of the current energy system in the world is the waste that the ecosystem of planet receives [8]. But even with the existing alternative methods of energy production, humanity cannot follow them.

The energy is in different forms, such as chemical, nuclear and thermal. In order to convert coal or uranium into energy, mankind has come up with a universal method - a turbine. It was Heron, a Greek who noticed that steam from water boiling over a fire can escape through the tubes and rotate the steam [1]. At that time it was nothing more than a toy, but after two thousand years we just replaced the fire with huge boilers, where tons of coal and gas are burned, and instead of a ball, we made a turbine and connected it to a generator, which generates electricity. Even those sources, in which nothing burns, still boil water in order to cause the steam to turn the turbine. For example, pipes with water are lowered underground at geothermal stations, where the temperature is high, the water is boiled there, and the turbine is turned with the resulting steam [2].

As for alternative energy sources, two types are used in large quantities: solar panels and wind turbines. These sources are currently the main trend in energy, but they appeared a long time ago, the first electricity from the wind began to be made in 1887, and the first solar batteries in 1883 and were first used in space, in 1958, to power satellites. Both of these inventions date back to the same decade as the first coal-fired power plants. Alternative energy appeared a long time ago, at the same time when traditional energy appeared, and now it is even cheaper.

"According to IRENA's annual Renewable Capacity Statistics 2019, global renewable generation capacity reached 2,351 GW. The three alternative energy sources with highest percentage are:

Hydropower accounts for 1,172 GW, which is about half of the total amount.

Onshore and offshore wind energy come second with 564 GW.

The capacity of solar power is slightly less — 480 GW, divided between solar photovoltaic and solar thermal power" [9, www].

The main part. Alternative energy sources are forecast to expand in every sector by 2023.

In order to supply the whole world with energy from solar panels, an area the size of South Korea is needed, and a place where many sunny days

per year is very large, for example, like the Sahara Desert with more than three hundred sunny days. This idea satisfies environmentalists, but will bring down the entire world energy system due to several reasons:

1. The first one is in the fact that material, wind and sun are renewable resources, but what turns wind or solar energy into electricity, complex structures are needed and they can not be deeply created from renewable resources. "The extraction of resources for such a number of wind turbines or solar panels are huge, also fiberglass, from which the wind turbine blades are created, does not decompose and now thousands of blades are just waiting for them to be buried, thereby the transition to "clean" energy generates a new wave of garbage"[9, www].

2. The second reason is that while we are consuming energy at a certain time, e.g. in the daytime, electricity consumption is distinctly reduced, since most fittings are used less at this time because people are working. Thus, solar panels, depending both on the sun shines at a time when people do not really need energy, and on a cloudy day will give an energy minimum, wind turbines, in turn, are unpredictable. That is why it is impossible to control the generation of electricity.

In recent years, many scientists state there have been strategy changes in international policies about the environment and sustainable development, especially in shipping (Soto J.L. Fernández, Seijo R. Garay, Formoso J.A. Fraguela, Iglesias G. Gregorio, Couce L. Carral, Manzon Luciano, Hadžić Neven, Kozmar Hrvoje, Tomic Marko). Shipping faces strategic challenges today: impact on climate change and escalating energy costs. The focus has been on the agents and activities that exhaust natural resources and harm the environment. The International Maritime Organization (IMO), shipping companies and international organisations are trying to reduce the polluting emissions and greenhouse gases generated by vessels.

This article looks at various alternative energy sources that can be used to power vessels and their auxiliary equipment, as well as at their economic and environmental repercussions on the transport of goods by sea.

The research of better efficiency measures should concern all areas of energy loss. The energy efficiency investments, which resulted to high cost products represent a challenge needed for the shipping industry. "The shipping industry plays a critical role in the global economy, carrying approximately 90% of the total tonnage of world's traded goods" [6, www]. Shipping propulsion has changed from the renewable energy of sail power to the predominance of heavy fuel oil and marine diesel oil. But renewable energy technologies could transform at all levels and scales the global shipping.

Renewable power applications for ships of all sizes include options for primary or hybrid propulsion, as well as use of on-board and shore-side energy [6, www]. "Renewables can be integrated through retrofits to the existing fleet or incorporation into new shipbuilding and design, with a small number of new ships striving for l00% renewable energy or zero-emissions technology for primary propulsion in the long run" [6, www].

Certain applications can offer immediate growth potential, even if the renewables contribution to the energy mix of the shipping sector remains limited in the near terms.

The International Maritime Organization (IMO) has called for improving energy efficiency in new ships. But the transition to a clean shipping sector requires a rapid shift back to energy-efficient designs using renewable energy technologies [3]. MARPOL Convention states that periodical surveys should be conducted to ensure that fitting, arrangements, structure and material comply with the requirements if conventions where the duration of the International Prevention Certificate is extended as specified in Regulation [4]. Chapter II – Requirements for control of operational pollution raises questions of maritime pollution [4, p.56].

The issues of better efficiency measures are to touch upon all aspects of energy loss. Breakthrough solutions are necessary in propulsion, hull and auxiliary domains whilst not forgetting the significant areas of energy management and ship operation. There are two important points to be taken into consideration:

1. Efficiency measures are differentiated according to the operational profile and the type of the vessel;

2. Increasing efficiency measures are not cumulative in general [7].

This highlights the important role of a ship designer who is to choose and integrates various possible technological solutions for the best overall ship's performance.

Coming research areas that can meet the strategic aims could address the certain aspects (table 1).

Innovative solutions are expected "for the monitoring, control and automation suitable to optimize the energy use on board permitting cost efficient operations in different vessel conditions" [5, www].

All these issues are the maritime technology industry and is reflected in the strategy of the Waterborne and the research program "Vessels for the Future". It is stated that a Private Public Partnership can tackle the challenges connected with energy efficient shipping and safety. Thus they encourage a change in perception of shipping and alter the operation state fundamentally, when compared with today [5].

Table 1 – Advanced technological solutions

Hull	computer Fluo-Dynamics tools developments for eco-efficient design in order to innovate hull forms for multi-mission operational profiles; viscous resistance reduction identifying laminar hulls concepts; wave-ship motion optimization; advanced hull designs for inland/shallow water navigation; new molecules for hull treatment reducing resistance and combining anti-fouling properties and next generation propulsors
Materials	the lightweight / higher strength composite materials application (e.g. metal foamed sandwich) and the relevant joining techniques
Engine	marine engines combustion optimization (compression ratio, injection timing, fuel spray geometry, etc.); renewable energy propulsion (sea and solar power, wind); alternative fuels (LNG, ethanol, methanol, DME, biodiesel and biogas); fuel cells that can run on hydrogen as auxiliary propulsion power; and in a longer term vision a diverse fuel mix adoption, with LNG, biogas, and hydrogen and batteries produced from renewable sources

Source:[5].

Conclusion. Thus, everything is based on nuclear and coal power plants; they function to provide the different installations with a vital minimum of electricity, then thermal power plants are connected in order to provide the world with energy, plus what coal and nuclear power plants give when more electricity is needed. The IMO has called for improving energy efficiency in new ships, and that transition to a clean shipping sector requires a rapid shift back to energy-efficient designs using renewable energy technologies. Innovations are expected regarding the hull construction, the lightweight / higher strength composite materials application and Combustion optimization of marine engines.

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Аннотация. В статье описываются альтернативные источники энергии, которые, по прогнозам, вырастут во всех секторах к 2023 году. Проанализированы основные проблемы и альтернативные источники энергии для судоходства. Подчеркивается важная роль судового проектировщика, который должен интегрировать различные возможные технологические решения для достижения наилучших общих характеристик корабля. Ожидаются прорывы в конструкции корпуса, применении легких / высокопрочных композитных материалов и оптимизации горения судовых двигателей.

Авторы выдвигают идею повышения энергоэффективности новых судов в соответствии с Конвенциями Международной морской организации. Был сделан вывод, что переход к сектору экологического судоходства требует быстрого возврата к энергоэффективным конструкциям с использованием технологий возобновляемых источников энергии.

Ключевые слова: Международная морская организация, альтернативная энергетика, энергоэффективность, возобновляемые источники энергии, конструктор судов.

Annotation. Alternative energy sources which are forecast to expand in every sector by 2023are described in the article. The main issues and alternative energy options for shipping are analyzed. The important role of a

ship designer is highlighted who has to integrate various possible technological solutions for the best overall ship's performance. Breakthroughs are expected regarding the hull construction, the lightweight / higher strength composite materials application and Combustion optimization of marine engines.

The authors put forward the idea about improving energy efficiency in new ships as it is specified by the International Maritime Organisation Conventions. In was concluded that the transition to a clean shipping sector requires a rapid shift back to energy-efficient designs using renewable energy technologies.

Keywords: the International Maritime Organisation, alternative energy, energy efficiency, renewables, ship designer.

PHYSICAL ANALYSIS OF WATER DISTILLATION USING PASSIVE SOLAR STILL

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Introduction

The need for fresh water is becoming an increasingly important issue around the world. Freshwater scarcity is an important problemin a lot of regions of the world.Infact, drinking water resources are operated and polluted by people. Drinking water is very scarce especially in developing countries, and the human habitat in these areas is highly depend on water availability in area. The importance of fresh water shouldn't be overemphasized. There are a lot of methods available for cleaning salt water. Solar is still simple and economical. It is worth noting that the lack of fresh contributes to the spread of diseases in these countries. Solar power is still a widely used water desalination device. The single slope solar stationis the basic solar station model for distillation salt water (Figure 1). The solar station at the bottom consists of a pool that is isolated with special material to reduce heat loss. The top of the distillation still locates condensate lids. The station providean outlet for collecting distilled water and an inlet for salt water access.
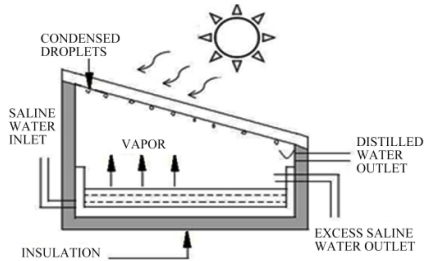
Figure 1– Skeleton of a basin solar

The influence of different parameters on the operability and performance of the device

The solar still performance depends on the various parameters. Some parameters such as solar radiation intensity, temperature and wind velocityare uncontrolled because they are metrological indicator. Oher parameters such as water depth and glass thickness are controlled because they are managed by humans. Also due to the higher intensity of solar radiation and energy, the total heat loss coefficientincreases up to maximum values. Kalidasa Murugavel presented his hypothesis that with a large difference in temperature between water and glass, the productivity of the station increases [3]. Ahmed et al. proved this phenomenon experimentally [1, 2, 5]. Other research groups proved that an productivity is caused by an increase in the collector area and a decrease in the thickness of the glass cover. It has also been shown that sun productivity decreases linearly with water depth.

Experimental Setup

One solar pool, made of copper sheet, was sized for a pool size (shown in Figure 2). Copper has a higher thermal conductivity, and the rate of heat transfer to water in a stationary state is faster. The poolattached in a wooden box with an internal section. To keep the pool stationary inside, scientists use plywood as the outer C-shaped covering. The gap is filled with sawdust to prevent heat loss. The copper sheet was fabricated into a rectangular tray by bending and cutting the sheet metal. The top of the basin is covered with a 5 mm thick transparentglass.The effective areaof the solar still for saline water is 0.27 m^2. During the experiment, scientists measured key parameters such as the solar radiation intensity, the glass and the basin water temperatures, and the ambient air temperature [2, 4].

Figure 2 – Solar still made up of copper

Experiment plan

All key measurements (solar intensity, wind speed, ambient, glass inside, glass outside, steam, water, pool temperature and distillate yield) are taken hourly. It is done to study the effect of each parameter on the performance of the station. The water level in the solar pool is maintained at 1 cm with a constant pool water mass of 2.7 kg. The readings are taken at one hour intervals before sunset. The same measurement process is repeated with changing the water level to 3 cm and 5 cm. The copper sheet is done ted black.

Experimental conditions and results

The experimental study is performed at Nazareth, Tamil Nadu, India. Experiments are fulfilled from 7:00 a.m. to 5:00p.m. during bright sunny days. During the experiments, key measurements are recorded. The average solar radiation is 750 W/m². It has been noticed that solar radiation changesparabolically during theday, maximum value is observed at 1.00p.m. The water temperature is low in the morning,so a large energy is required to change the phase from liquid to saturated vapor phase. The ambient temperature gradually increases in a straight line from the morning until the end of the experiment. According to the results, temperature and required heat are inversely proportional. Since the water temperature reaches a maximum only at noon, less heat is needed for evaporation, and in the evening, on the contrary, more. The average wind speed was 2 m/s. Wind speed is an important parameter, because it directly affectson the temperature of the glass, as it is the natural cooler of the station. Moreover, the temperature of the glass ultimately affects the maximum yield from the station.

The maximum thermal efficiencies achieved by theexperimental setup is 40% and 22% for the summerand winter respectively. The yield of the still was higher when compared to thegalvanized iron sheetstill in both the summer and winter.

Conclusion

Thermal conductivity and dynamic viscosity increase with time and have almost the same tendency. In the course of these experiments, a change in the density of water for a cube was found and ranged from

1.094133 to 1.1025812 kg · m^3. It is noticed that the density decreases with increasing water temperatureand respectively vice versa. The amount of daily collected output of distillate is 1.09 kg / day. Station efficiency increases over time.

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Аннотация. Статья посвящена решению проблемы дефицита пресной воды. Рассмотрен метод, который может быть использован для увеличения запаса пресной воды. Представлен обзор факторов, повышающих эффективность метода. Выявлены проблемы, которые могут быть оптимизированы.

Ключевые слова: Солнечная неподвижность, Внешняя среда, Конвекция, Испарение, Солнечная энергия

Annotation. The article is devoted to solving the problem of freshwater scarcity. The method that can be used to increase the supply of fresh water is considered. An overview of the factors that increase the efficiency of the method is presented. Problems that can be optimized are identified.

Key words: Solar Still, Ambient, Convection, Evaporation, Solar Energy.

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MUSIC-EVOKED AUTOBIOGRAPHICAL MEMORIES IN ALZHEIMER'S DISEASE

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Introduction

Alzheimer's disease (AD) is a worldwide spread neurogenerative disorder that affects around 50 million people worldwide. Symptoms include memory and language impairment, with serious consequences for interpersonal communication and the sense of self and well-being in AD. Due to AD having no cure at the moment, diagnosis is crushing for both patients and caregivers. Ways of improving communication have the potential to improve quality of life of both a person afflicted by AD and the caregivers.

Music therapy

Music has long been thought to be therapeutic and is seen as an important component of dementia care and treatment, but empirical studies of musical therapy were proven that therapy to be controversial. Authors of the article offer different approach, which is to focus on the implications of a particular findings: musical memories, which is familiarity for music heard in past, are preserved in healthy aging, early stages of AD and sometimes even during later stages of AD. Musical memories may also be associated with other, nonmusical, memories that are previous personal experiences, or autobiographical memories. To evoke music-evoked autobiographical memories (MEAMs), musical excerpts are played to participants who are asked to describe any memory from their recent or remote past that was brought to mind by the music. In contrast to usual

autobiographical memory test that requires a direct memory search, MEAMs come to mind spontaneously, are triggered by a perceptual cue and may be considered involuntary memories.Many researchers have provided strong evidence that music evokes memories more effectively than do specific instructions to recall in silence.On multiple studies prior to the referenced here, AD patients responded with MEAMs, given the known deterioration of autobiographical memory accompanying the disease and the memories evoked by the music were influenced by something known as the positivity effect.

Positivity effect

In general, the positivity effect refers a phenomenon, in which older adults reveal a relative preference in attention and memory for positive over negative information in comparison to younger adults, regardless of the memory content or context. The nature of this phenomenon isstill not agreed on and the positivity effect may be either the adaptive, healthy or nonadaptive, unhealthy process.The positivity effect may or may not be present at AD, as multiple studies have shown previously, and the current researchers present a study designed to assess the presence of the positivity effect in MEAMs with 20 healthy older adults(OD) and 20 persons with AD(AD). The data from these two groups were compared with those from a group of 20 young adults(YA). The positivity effect was expected from healthy adults because of involuntary, less cognitively controllable nature of those memories and because fewer demands on memory-retrieval resources release cognitive resources for emotional control in aging [3].

Testing method

Additionally, twelve instrumental tunes were included, because songs with lyrics would confound the role of music and words, and using one or two pieceswould not give sufficient data to justify the relation. Three different responce measures were included, being linguistic analysis of words that were used to describe the memory, distribution of content topicby positive/negative, and self-rating on two scales, one reflecting the positivity of the memory, the other the negativity.In addition, mood-congruence hypothesis was checked: The mood-congruency hypothesis predicts that emotional valence of the memories will be strongly related to current mood, especially in older people who tend to report more positive affect. Mood was assessed by administering the Positive and Negative Affect Scale before and after collecting MEAM data.Volunteers had different length of formal music training (<1~10 years), at least attended high school, did not have crucial hearing loss, did not live in the institution (except four AD who resided in long-term care facilities) [2]. OD passed MMSE with a minimum score of 28/30.Additionally 4 AD patients with

mixed dementia were included as long as exactly AD was responsible for their cognitive impairment.Of the 24 participants, 20 (termed "responders"; 10 females) provided at least one MEAM and 4 (termed "nonresponders"; 2 females) were unable to provide any MEAMs. There were no easily identified factors that could make nonresponders in a distinct group, for example, no correlation of response, musical trainingand MMSE scores was found. Thus, only responders' data was used later in the analysis.All tunes were used in 30s cuts, were somewhat familiar and were considered pleasant by every test subject. The excerpts were in their original instrumentation. Examples of tunes were "The Sorcerer's Apprentice" by Paul Dukas and "In the Mood" by Glen Miller.Participants were set in quiet comfortable places, organisers asked them control questions on how they feel, instructed them to listen to music and to describe the spontaneous memory that got arisen during the music if any. Test administrator would ask test subjects on detailed nature of the memory, like vividness and emotional footprint. Later different measures were given intended for AD, like dementia and depression rating scales [1].

Results

After statistical analysis of the data measured, such correlations were noticed:

For the OA versus AD contrast, the only measure that was significantly different was the percent of MEAMs identified by participants as specific, with OA being higher than AD (50% versus 10%). For the YA versus (OA + AD) contrast the age range of the memory, percent of MEAMs identified as specific, and vividness rating were all significantly different. The younger group reported their memories to be more specific, but less vivid, than the combined older groups. In sum, the effects of age were more prevalent than the effects of the disease.For AD, a larger number of MEAMs was associated with earlier memories. Specificity and periodicity of memories was also researched, and it shows that the effect of age is more evident than the effect of the disease, with, as might be expected, specific episodic memories less available in older age.Although AD nonresponders did not form a separate group in correlation to any other feature, they have shown worse MMSE scores, probably due to a more severe impairment that MMSE or similar diagnostics could detect.The presence and the impact of positivity effect on AD vs OA was tested by a few methods, and, as a result the word count analysis method was concluded as unreliable due to lack of emotion words, content topics pointed towards a positivity effect where memories of positive topics are more frequent for older than for younger adults,the subjective ratings support an effect of age rather than that of disease, and of the three above

measures most clearly reflect a positivity effect.In addition, mood-congruence hypothesis was proven false for YA and OA, however, there was a correlation in mood of AD's and their memories' positivity/negativity.AD and OA groups' age was slightly different, AD group being older, yet age difference was shown to be insignificant.

Composer	Title	Start bar number
Khachaturian, Aram	Sabre Dance from Gayane	3
Miller, Glen	In the Mood	1
Irish Traditional Music	The Irish Washerwoman / The Washwoman	1 (pickup beat)
Boccherini, Luigi	Minuet from String Quintet in E Major, Op.11, No.5 (G275)	1
Mexican Folk Dance	La Raspa	1
Dukas, Paul	The Sorcerer's Apprentice (L'Apprenti Sorcier)	72
Thomas, Werner	The Chicken Dance	1
Tchaikovsky, Peter Ilich	Trepak (Russian Dance) from The Nutcracker	1
Vivaldi, Antonio	Concerto No.1, La Primavera, Spring, Frühling, Op.8, No.1, RV 269, Allegro	1 (pickup beat)
Strauss, Johann	An der schönen blauen Donau op. 314 ("Blue Danube Waltz")	45
Wagner, Richard	Bridal March (Lohengrin)	1
Beethoven, Ludwig von	Symphony No. 5 in C minor, Op. 67, 1st movement	1

Figure 1 – Music samples used

Conclusion

Thus, we can conclude few important results, first being that no effects of AD was displayed in relation to memory evocation and content, provingpositivity effect in AD, showing that involuntary memory evocation may be an automatic process, and these memories may rise despite the degenerative loss of executive control and attention in AD. In sum, the positivity effect in AD may signal a positive and controlled sense of self that still exists despite the disease. This implies that despite AD affecting crucial cognitive functions, AD patients may still preserve and recall memories via MEAM phenomena and enjoy music and these memories. Although, currently the data was limited and there weresome AD patients that did not recall any memories, this research provides vast room for improvement both in practical treatment of the patients and theoretical understanding of AD's sparing mechanism, that in turn may be the key to finding cure to the disease altogether.

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Аннотация. Это исследование было направлено на попытку найти наличие музыкально-вызываемых автобиографических воспоминаний и эффекта позитивности в воспоминаниях больных болезнью Альцгеймера, а также проверить несколько связанных с этим гипотез. Исследование было успешно проведено, статистический анализ полученных данных доказал наличие обоих эффектов и была показана перспектива развития направления данных исследований и в практическом смысле облегчения страданий больных и ухода за ними, и в теоретическом смысле с дальнейшим потенциалом найти лечение от болезни.

Ключевые слова: Болезнь Альцгеймера, нейродегенеративные болезни, эффект позитивности, гипотеза соответствия настроению, музыка в лечении, непроизвольные воспоминания.

Annotation. This study sought to find music-evoked autobiographical memories and the positivity effect on Alzheimer's memories, and to test several related hypotheses. The study was successfully carried out, the statistical analysis of the data obtained proved the existence of both effects and there is a prospect for the development of the direction of these studies and, in a practical sense, alleviating the suffering of patients and caring for them, and in a theoretical sense, with the further potential to find a cure for the disease.

Keywords: Alzheimer's disease, neurodegenerative diseases, positivity effect, mood-congruence hypothesis, music in treatment, involuntary memories.

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GLOBAL DEMANDS OF THE TRAINING IN MARITIME ENGLISH

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Introduction

European countries are at present adapting their university degrees to the European Space of Higher Education (ESHE) in compliance with the Bologna Declaration. Maritime studies, being a part of the University degrees offered inEurope, are no exception to this. The changes brought about by ESHE obligeMaritime Schools (known as MET institutions) to resort to a credit system tosignify workload, to reorganize courses offered, to update syllabus designs, to takeinto consideration competences and learning outcomes, to adapt teachingmethodologies to teachers and learners' new roles, and to renovate teachingmaterials to satisfy the latest technological innovations pertaining to seabornetrade and the global demands of the shipping industry [1].

The practice of deck and engineering crew training in Maritime English is carried out in closeconnection with development of national and international standards. A standard serves as a model, asample. It is established by professional administrations, and represents a level of quality or achievement used for judging someone or something. Even when national standards in Maritime English are available,they still differ in various countries.

National Maritime English standards in detailed form do not exsist in Russia. The National Standard of Maritime Education for Bachelor and

Master Degrees both deck and engineering departments suggestonly general instructions and notions. The achievements of Russian Maritime English specialists aresignificant [2], [3] [4]; still they have not as yet crowned with job-orientated standards. At the sametime, international organizations and all parties involved demand global standards of Maritime English with the intention of removing the differences between the seafarers trained in English speakingcountries and those who receive Maritime education and training in non-English speaking countries.

Therefore, the MarTEL Project partners are rightly interested in dissemination of both ideas ofinternational standards and materials developed to support them. In this situation, the international Maritime English standards is expected positively to influence the creation and further development ofnational Maritime education standards and help to unify requirements of all institutions dealing with recruiting and certification of seafarers.

Aspects of maritime English

Linguistic aspect. Researchers emphasize on the global nature of English (Global English, InternationalEnglish), call English lingua franca. For people who work inmultinational working environment, Maritime English is considered to be an operational language, the language with some restrictions if the functional characteristics are concerned in the specific area of merchant marine transportations. The linguistic analysis indicates the availability of considerable lexical "burden" of special terms, relatively a short list of grammar structures and strikinglyserious set of phonetic peculiarities in Maritime English use.

The problem of co-relationship of General English and Maritime English appears when developing the assessment and various teaching/learning materials(studybooks, in particular) that meet all vital needs of the learners at different level of proficiency. Thereare also methodological, psychological and social issues related to the efficiency and effectiveness oflanguage learning.

Methodological aspect. The most serious platform for practical researches is ESP (English for Specific Purposes). After the revolution in linguistics, when it was found out that any language analysis presumesthe study of actual communication materials, it became obvious that the methodological aspirationsshould be focused exceptionally on the learners' needs, meaning that theprofessional needs acquirepriority (development of skills for a givenvocation/employment). Learners' language skills, viz., listening, speaking, writing and reading combine the competence which is defined sufficient or insufficient for theirprofessional activities.

The MarTEL Project partners have been developing a system of tests which takes into account real communication needs of the seafarers. Thus, the project concentrates on thecoordination in work of Maritime specialists and language teachers. This is the area of mutual interests where training of teaching staff in rather specific sphere, namely shipping, has and appears to be a great challenge.

Psychological aspect. Discussions on the problem of appropriate method of selection have proven thatthe best one is the method which is the most adequate for the learners and their vital interests. Variety of tasks, learning materials, study packs as well as sufficient level of the learner's motivation guarantee theopenness of both the student and the teacher, evoke the response to real communication and the interestto the future profession.

Social aspect. It is known, that the labor market is the best factor for motivating students in the processof their studies. In the industry of water transportation this problem is being solved through acquiring by students and graduates of real communication experience working in multi-national environments when some incidents of intercultural and interconfessional nature may take place. Moreover, sociolingual andsociocultural aspects combined with specific labor conditions on a merchant vessel, climatic and weather factors in everyday work of seafarers, pressure of working conditions, isolation in longvoyages, health problems, together with the special seafarers' status require extreme concentration and hard work in the course of their professional training including Maritime English proficiency, thus, makingthem achieve the highest level of professional competency in order to be safe at sea, avoid risks ofendangering others and reducing the chances of damaging property [5].

Designing internationally unified MET programmeschallenges

Learners of Maritime English, depending on their background and different nationalities, will always have different needs and expectations of themselves and their tutors, which in turn determine course content at local level. In addition, international standards recommended for inclusion in Maritime English courses are always complemented, or altered in some cases, by national standards as both regulate the local MET curriculum. This generates a very uncertain situation for the Maritime English trainer. One example of how radically different the teaching andlearning activities, the prerequisites and the learning outcomes may be for the Maritime English learner around the world– and not even mentioning conceptual thinking, learning strategies or motivation – is to highlight the difference in approach to teaching between native speakers of English and non-native speakers. Native speakers of English and non-native speakers of English will always have a very different initial conception about their need to learn

Maritime English as cadets, which includes the desire not only to learn Maritime English in school, but also tokeep developing it, throughout life.

Consequently, any Maritime English course designed anywhere in the world is conceptually different to courses given in another part of the world, as it will be conditioned in its designwith the learners' particular situatedness, prerequisites, and needs in mind. But as these parameters are very unlikely to overlap at a global level, and as globalization should be the common goal of the Maritime Industry, perhaps the discussion about how to design internationally unified MET programmes must take a goal-oriented turn. This means that MET worldwide must bebased on the standards that all IMO member countries have ratified, before it can deal with cadets' needs, prerequisites or situatedness.

It has been suggested in several IMEC contexts that MET institutions should collaborateinternationally to develop joint aims and objectives which meet the IMO STCW requirements ina way that the Maritime Industry can agree upon, in addition to meeting national standards.

Maritime English must be taught to the minimum level of proficiency as outlined in the STCW.If this were the case, locally developed teaching and learning activities, learning outcomes andassessment methods may not be enough to satisfy the IMO requirements if they do not descend from the international agreement or are not aligned with the same.

Multiple authors at previous IMECs have discussed that Maritime English needs: globally aligned assessment procedures optimization within the training of communication skills atsea cross-curricular collaboration among trainers, i.e. twinning and intercultural communication must be given right of way in our 80% multicultural crews. Therefore, a call to action exists for IMEC and IMLA to enable lecturers worldwide to join the roundtable which these conferences aim to represent in the maritime discourse, and start working onmaking Maritime English evident in IMO documents around the world.

The discussion about internationallyteaching and learning activities of Maritime English requires clearly defined parameters of thesame while taking learning processes and the IMO STCW aims and objectives of Maritime English training into account. Maritime English is also a restricted language defined by itsparticular setting. It aims at facilitating communication not solely at sea, therefore the partakers in the communication processes which take place in this given setting, and in the circumstances under which they might act in their various professional roles, must be taken into account. Forthis, as Maritime English instructors, we may need support and guidance in a twinning manner.

Because of vast international requirements and legislation within this industry, as well as thenational and institutional expectations and demands, the Maritime English tutor is oftendepending on the pedagogical environment that is created within each MET institution.

Therefore, the responsibility for Maritime English proficiency as identified within the STCWcode have been laid on the responsible institutions, and not the Maritime English instructors.

Considering the above, we would like to paraphrase Professor Doctor Peter Trenkner, who in his opening letter for the IMEC22 in Alexandria wrote that we should "teach locally but thinkglobally". This is a call for a more global teaching approach, where we, as Maritime English instructors, think locally of the particular needs and prerequisites of our students. The final word of the day must be globalization of MET institutions as we start working towards internationally unified graduate attributes for our cadets [6].

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Аннотация. В данной статье говорится о морском английском, его аспектах, нормах и стандартах преподавания языка, перспективах и методах обучения студентов морскому английскому.

Ключевые слова: морской английский, стандарты, аспекты, обучение.

Annotation. This article talks about Maritime English, its aspects, norms and standards of language teaching, prospects and methods of teaching students Maritime English.

Keywords: maritime english, standarts, aspects, training.

METHOD FOR DESIGNING COGNITIVE MAPS IN FOREIGN LANGUAGE TEACHING

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Introduction. The problem of the development of cognitive interests has become urgent in modern practice of teaching in a pedagogical college, since special attention is paid to the personality of the student as a subject of activity. The aspect of the formation and development of students' cognitive interest is important due to the high requirements for the level of foreign language proficiency of graduates [5]. The basis of the educational and cognitive activity of a college student is the motivation of cognition, which arises in a problem situation and develops with the correct interaction and relations between students and teachers. Modernity makes high demands on the skills of foreign language communication in everyday communication and in the professional sphere [7].

Analysis of research and publications on the research problem. Issues related to cognitive interest are given great attention in the works of scientists B.G. Ananyev, L.S. Vygotskiy, P.Ya. Galperin, A.N. Leontiev, L.S. Rubinstein, N.F. Talyzina, etc.) The problem of personal achievement formation in teaching English through maintaining interest in the subject is an aim of the works of L.S. Menkova, S.S. Avganov, G.V. Rogova, E.M. Spirina, E.Yu. Nazarova and others.

Personally-oriented learning in modern schools in the framework of the development of cognitive interests was considered by Sh.A. Amonashvili, V.V. Davydov, I.S. Yakimanskaya, D.B. Elkonin et al. The role of a foreign language in the development of cognitive interest was studied by S.L. Volkova, G.I. Shchukina, E.M. Vereshchagin, V.G. Kostomarov and others. Cognitive interest as a base of external and internal resources of objective and subjective sides of joint learning activity becomes a factor in improving learning [1].

Innovative technologies in the conditions of foreign language learning are reflected in the works of I.G. Zakharova, O.N. Kruchina, M.A. Palagutina et al. The possibilities of designing cognitive maps in

teaching a foreign language have not been sufficiently considered in pedagogical theory and practice.

The **purpose** of this article is to determine an effective way in teaching a foreign language in order to develop the cognitive interests of students.

Main part. Taking into account the specifics of teaching a foreign language in college, it is most expedient to use the linguistic and cultural aspect for the development of the cognitive interests of students [4]. "A foreign language should become a reliable means of getting involved in scientific and technical progress, a means of satisfying cognitive interests for students. Therefore, it is natural for students to expand and deepen the subject at the expense of country geography, general humanitarian or technical material, focused on the future specialty of students" [5, p. 24]. "Motivation of activity is provided by the possibilities of choice and elements of competitiveness, its voluntariness, self-affirmation, self-realization of satisfaction of needs" [3, p. 79].

The application of the method of designing cognitive maps in the process of learning a foreign language makes it possible to simulate learning situations for the development of foreign language communication skills. This technology also increases motivation to study, make one takes a fresh look at the subject being studied [6].

Methodologically, cognitive modeling, focused on improving the analysis and modeling of pedagogical situations, is used by teachers of Institute of Education Development in Sevastopol. Using the method of designing cognitive maps of lessons, foreign language teachers have learned to create independently. Using a wide range of open electronic educational resources, a modern and interesting lesson is designed on the basis of traditional teaching materials. The cognitive map of the lesson is used as an element of remote support of the main educational program.

Cognitive maps of lessons combine both linguistic material and information about the national culture of peoples, which acts not only as a means of communication interaction, but also as a way to get acquainted with new reality. Using the method of designing cognitive maps in teaching a foreign language in order to develop cognitive interests significantly improves the quality of vocational training. "The work of students becomes more intensive, which allows to increase the pace of studying the educational material and to increase the volume of independent work in the classroom and after them" [3, p. 27].

By means of Mind Manager it is possible to design cognitive maps with the help of following methods:
1. Brainstorming (business meetings, project planning) [8];

2. Data visualization (organization charts, project management; presentations, link diagrams, forecasting);

3. Block diagrams (process control);

4. Project management (Gantt charts; timelines; project planning) [9].

As an effective way of memorizing new vocabulary, establishing associative links and systematizing lexical and grammatical material in the English language, it is advisable to draw up memory maps– visual thinking, graphical representations and the process of creating diagrams.

Picture 1 – Mand Mapping
Source: https://www.mindmeister.com/blog/tony-buzan-tribute/

The system of tasks based on cognitive maps, which helps to improve the skills of finding information in the text, is based on the method of cognitive visualization and includes the following stages:

1. Acquaintance with the text, the study of graphic images (photographs, diagrams, graphics).

2. Search for statistical data, their graphic representation.

3. Formation of critical thinking skills. One should determine whether a given statement refers to fact or opinion.

4. Designing the mind map of the text.

5. Drawing up the mind map of the problem essay.

6. Consolidation: discussion, reflection of one's own educational activity internalizes the language content of training [2].

Thus, cognitive visualization is a way of cognition and development of thinking, which helps to optimize learning, motivation to learn a language.

Conclusions and recommendations. The method of designing cognitive maps in the process of foreign language learning increases cognitive motivation, expands the possibilities of the linguistic and cultural aspect in teaching a foreign language by combining linguistic material and information about the national culture of peoples. The use of the method of designing cognitive maps in order to develop cognitive interests significantly increases the quality of professional training.

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Аннотация. Проблема развития познавательного интереса у студентов педагогического колледжа важна в силу высоких требований, предъявляемых к уровню владения иностранным языком выпускников. Рассматривается перспективный метод проектирования когнитивных карт в обучении иностранному языку как эффективный способ обучения иностранному языку.

Ключевые слова: педагогический колледж, когнитивная визуализация, когнитивные (ментальные) карты, иностранный язык**.**

Annotation. The problem of cognitive interest development in pedagogical college students is important due to the high requirements for the level of graduates' foreign language proficiency. A promising method for designing cognitive maps in teaching a foreign language is considered as an effective one.

Keywords: teacher training college, cognitive visualization, cognitive (mental) maps, foreign language.

INTERCONNECTION OF ACCENTUATION OF CHARACTER AND INTERNET DEPENDENCE IN TEENAGES AGE

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Introduction. Internet dependence of adolescents is a global psychological and pedagogical problem that needs to be solved immediately. The term "Internet addiction" was coined by Dr. Ivan Goldberg in 1996 to describe an unknowingly long time on the Internet. At the present stage, actual problems of dependence psychology are being actively discussed which are associated with attempts to isolate behavioral forms of dependence [1, 2]. In fact, the question is about the absolute

differences in the ways of "leaving" from real life to the virtual world by changing the state of human consciousness.

Materials and methods. The aim of our study is to identify the relationship between the types of character accentuations and the risk of Internet dependence in adolescents.

To achieve the goal of the research, the following psychodiagnostic techniques were used: "Character accentuation questionnaire" (the authors – K. Leonhard and G. Shmishek); Internet Dependence Test (authored by Dr. Kimberly Young), and the method of descriptive and mathematical processing of primary data.

The research was carried out in the State Budgetary Educational Institution "Secondary School No. 14 named after Pyanzin" during the 2020-2021 academic year. The study involved 25 adolescents aged 13-14 years. The average age is 13.6 years old.

According to the character accentuation test, the following accentuations were found to be the most signified: hypertensive (17.5); exalted (16) and pedagogical (15.6).

And according to Young's test, Internet dependence is more signified in girls (82%) than in boys (73% of respondents).

To confirm the statistical hypothesis, it is assumed that the effect of Internet dependence is affected by accentuation in adolescents, Spearman's rank correlation method was used.

Thus, according to the results of statistical processing, the following correlations were obtained:

1. Direct correlation between exaltation and Internet dependence ($r = 0.52$, while $p \leq 0,05$). This indicates that adolescents are Internet-depended on this accentuation, since in real life young people want increased attention from others, but in real life they do not receive it.

2. The tendency for an inverse correlation between dysthymia and Internet dependence ($r = -0.5$, while $p \leq 0,05$): adolescents with a pessimistic mood and outlook on life are not inclined to live in the network;

3. The tendency towards an inverse correlation between jamming and Internet dependence ($r = -0.35$, while $p \leq 0,05$). This fact proves that the manifestation of the accentuation of the nature of being stuck is less prone to Internet dependence, since the Internet is a sufficiently mobile system, which can disrupt the mental health of boys and girls of this type;

4. Inverse correlation between hyperthymia and internet addiction ($r = -0.4$, while $p \leq 0,05$). In this case, people with high activity, lust for life is less sensitive to Internet addiction.

Thus, the hypothesis of the study is partially proven. It is important to understand that character accentuation affects psychological addiction to the Internet. Knowing the features of accentuation, it is possible to develop a preventive program that allows youngsters to return to real life.

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Аннотация. В статье представлены результаты пилотажного исследования о взаимосвязи между акцентуацией характера и Интернет - зависимости в подростком возрасте. Было выявлено, что самая яркая связь между экзальтирностью и Интернет-зависимостью (r = 0,52 при р ≤0,05). Это свидетельствует о том, что подростки данной акцентуации не могут реализовать потребность во внимание со стороны окружающих, что и формирует компенсаторный механизм – реализация себя в сети Интернет.

Ключевые слова: подросток, Интернет, Интернет-зависимость, экзальтированная акцентуация характера.

Annotation: The article presents the results of a pilot study on the relationship between character accentuation and Internet dependence in adolescence. It was found that the most striking relationship between exaltation and Internet dependence (r = 0.52 at p≤0.05). This indicates that adolescents of this accentuation cannot realize the need for attention from others, which forms a compensatory mechanism – their realization on the Internet.

Keywords: teenager, Internet, Internet dependence, exalted accentuation of character.

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BLENDED LEARNING ENVIRONMENT IN HIGHER EDUCATION

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The COVID-19 pandemic and the resulting lockdown led to a sudden transition towards blended learning that has become a widespread phenomenon in higher education.Blended learning started to evolve at a rapid pace allowing students to study via the Internet being far from the universities. Blended learning is defined as a combination of conventional face-to-face and online approaches to instruction [1, p. 4], meeting needs of students and teachers, both technological and practical ones.

Analysis of the literature shows that there are various design approaches to blended learning courses. According to the researchers, the percentage of the content delivered online can range from 30% (web-facilitated course) to 80% (online course), while blended learning course combining online and offline practices takes 30-79%[2, p. 12]. We suppose that for university students the optimal blend should be about 50%, that is face-to-face training should be supplemented with online practices in approximately equal proportions.

Students' individual work and self-study is crucial for achieving learning outcomes, therefore it should be organized efficiently using virtual environments such as learning management systems (LMS). LMS Moodle offers a number of benefits both for learners and teachers: access to materials, feedback quality, communication tools, various tests, automatic assessment system, monitoring, user friendliness of the website and the like.

The integration of blended learning varies significantly depending on the subject context, aims of the course, learning activities and outcomes, students' needs and other factors. Successful implementation of a blended learning approach into higher education depends on its quality design. The design of blended learning courses involves the following stages: planning, designing, implementation, reviewing and improving [3, p. 8]. Planning of a blended learning course includes such aspects as defining the students' needs and expectations, learning outcomes, assessment tasks and feedback. At the designing stage the teacher is responsible for selecting the blended learning model, appropriate learning activities, strategies and resources. The implementation and reviewing stages require continuous monitoring aiming at providing the feedback and reflection from the participants of the

learning process. The final stage involves eliminating the shortcomings of the previous stages if there are any and improving the delivery of the course.

Considering the design of blended learning courses one should take into account the ways of integration of face-to-face and online practices, replacing and restructuring class hours, engagement and involvement of students in a new learning environment [4, p. 6]. It is important to point out that careful planning, continuous monitoring and evaluation of the course are necessary for effective integration of blended learning.

Rational combination of face-to-face and online practices adds value to learning in terms of flexible access to materials, students active learning due to interactive technologies and multimedia resources, immediate feedback, encouragement of learners' autonomy and independence.

Despite all the benefits of blended learning, there are a number of challenges that teachers face designing the course. First and foremost, it is the computer and technological literacy necessary for teachers to use the blended learning approach. Moreover, the lack of infrastructure and poor Internet access can hinder successful implementation of blended learning courses. For integrating information and communication technologies into their own experience teachers should be able to select, adopt and apply appropriate technological tools in relation with specific teaching goals. Increase of the workload, time constraints, insufficient incentives can have a negative impact on the teachers' use of e-learning courses [5, p.35]. In addition, extra online activities can also worsen students' attitude to blended learning, so the task of the teacher is to balance the proportion of online and offline materials.

To overcome the mentioned challenges, the institutional support in terms of teachers' professional development, technical expertise, finance, time management should be provided [6, p. 448]. If all points are taken into account, blended learning will be beneficial both for teachers and students enhancing the learners' engagement, achievements, motivation and flexibility. Moreover, blended learning enables the development of skills necessary for living and working in a digital world.

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Аннотация. В настоящее время все большее распространение получает смешанное обучение, поскольку оно наилучшим образом использует традиционные занятия в аудитории и электронное обучение. Смешанное обучение определяется как образовательная среда, объединяющая очное обучение и онлайн-практики**.** В этой статье рассматриваются подходы и этапы разработки курса смешанного обучения, преимущества и проблемы, с которыми преподаватели и студенты сталкиваются при применении смешанного обучения. Можно констатировать, что качественный дизайн курсов смешанного обучения положительно сказывается на достижениях студентов, их вовлеченности, мотивации, гибкости и автономии.

Ключевые слова: смешанное обучение, среда, дизайн, подход, онлайн, очная практика.

Annotation. Blended learning is gaining favor nowadays since it makes the best use of traditional classroom activities and e-learning. Blended learning is defined as an educational environment integrating face-to-face instruction and online practices. This paper deals with approaches and stages of blended learning course design, benefits and challenges that teachers and students face applying blended learning environment. It can be stated that the quality design of blended learning courses can have a positive impact on students' achievements, engagement, motivation, flexibility and autonomy.

Key words: blended learning, environment, design, approach, online, face-to-face practice.

METHODOLOGICAL PRODUCT AS A RESULT OF PROFESSIONAL SCHOOL TEACHER ACTIVITY

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The multifaceted methodological activity of professional school teacher finds its expression in creative results – methodological products that are the final result, a consequence of such activities and reflect developments and proposals for mass use by teachers and students. A methodological product is not an individual, but a collective result of the activity of a creative group of teachers in the form of an educational publication or methodological development, recommended by a methodological association or department for use in the work of teachers.

In order to optimize the methodological activity of teachers of a professional school, it is advisable for the direction of a university or a specialized secondary school to compile a selection of publications, which the teacher can be guided by when choosing the direction of his/her methodological search. One should give as an example a selection of publications compiled for teachers of "Sevastopol Industrial and Technological College named after Marshal of Engineering Troops A.V. Gelovani" based on [1].

Table 1. Example of a selection of publications

Edition type	The essence of the concept
Edition	a document intended for the dissemination of the information contained in it, having undergone editorial and publishing processing, independently executed, having output information
Educational edition	a publication containing systematized information of a scientific or applied nature, set out in a form convenient for study and teaching, and designed for students of different ages and levels of education
Textbook	educational publication containing a systematic presentation of the academic discipline, its section, part corresponding to the curriculum, and officially approved as this type of publication
schoolbook	educational publication supplementing or replacing partly or completely the textbook, officially approved as this type of publication

Educational-methodical book	educational publication containing materials on teaching methods, studying an academic discipline, its section, part or education
Educational visual book	educational publication containing materials to aid study, teaching or education
Workbook	a textbook that has a special didactic instrument that facilitates the student's independent work on mastering the subject
Self-instruction book	educational publication for self-study of something without the help of a leader
Reader	educational publication containing literary, artistic, historical and other works or excerpts from them, which constitute the object of study of the academic discipline
Workshop book	educational publication containing practical tasks and exercises that contribute to the material assimilation
Tasks book	work book containing educational tasks
Training program	educational publication that determines the content, volume, as well as the procedure for studying and teaching an academic discipline, its section, part
Training cards book	a set of educational publications intended for a specific level of education and including a textbook, study guide, workbook, reference edition
Information and methodological adds	–annotation; - bulletin; - newspaper; - messenger; - informational and methodical exhibition; - leaflet; - methodical information guide; - methodical commentary; - methodological description; - description of advanced teaching experience; - portfolio; - advisory bibliographic list (index); - essay; - abstract collection; - vocabulary.
Organizational and methodical adds	–instructional and methodological letters; - instructions; - methodical notes; - reminders; - provisions; - guidelines; - methodological developments; - collection of materials (abstracts) of scientific and practical, methodological conferences, seminars, "discussing tables"

Guidelines	a set of suggestions and instructions that contribute to the introduction of the most effective methods and forms of work to solve any problem of pedagogy
Methodical design book	a publication containing specific materials to help carry out an event, combining methodological advice and recommendations

For the purpose of standardization, the structure and approximate content of the structural parts of the methodological development should be specified for teachers, as well as the requirements for the design of methodological products, examples of which are presented below.

The structure of the methodological development includes the following components.

1. TITLE:

– the name of the educational institution.

- the name of the development.

- the name and form of the event.

- profession, specialty, subject according with methodical recommendations.

- author of the development, position, place of work.

- reviewer of methodological development.

- consideration and approval at a meeting of the methodological association (department).

2. CONTENT.

3. EXPLANATORY NOTE, which contains the theme, aims, tasks of the lesson, activities, the intended method of conducting, the group of students for whom the event is designed, as well as:

– conditions of implementation: material and technical and didactic equipment – equipment, design (technical means, versions of texts, slogans, posters, title and authors of musical works used in the script);

– methodological advice for preparatory work for the event, classes (correct distribution of assignments).

4. THE MAIN PART, which contains:

– plan, course, synopsis, scenario, flow chart of the event, classes.

– methodological advice, tasks, tests to consolidate the result, etc.

5. REFERENCES.

6. APPENDICES.

The approximate content of the structural parts of the guidelines:

Introductory part / Explanatory note / Introduction is an explanatory note, where the relevance and necessity of this work is substantiated, the purpose of drawing up these methodological recommendations is determined, a brief analysis of the state of affairs on this issue is given, it is explained what kind of assistance the work is designed to provide.

The main part / The content part consists of an analysis and description of advanced training technologies used by leaders and teachers to achieve their goals. At the same time, it is indicated what exactly is recommended to be done to correct and improve the existing situation, and a description of the prospects for the results of using the recommendations is given.

Conclusion. Here are brief, clear conclusions that logically follow from the content of the guidelines.

List of recommended literature. The list of references is given in alphabetical order, indicating the author, full name, place of publication, publisher, year of publication (according to GOST).

Appendices (memos, diagrams, graphs, drawings, photographs, test assignments, assessment sheets, presentation material, etc.).

General requirements for the design of methodological results.

Printed edition and electronic form in Russian, text editor is "Microsoft Word", font is 12/14 point size "Times New Roman", single spacing, file format – .doc, margins – 2 cm, pages should be numbered. Volume is from 28 pages and more (including attachments), depending on the type of methodological products. To prepare for printing, you need methodical products in book format A5. Requirements are specified depending on the type of methodological products. The list of references is drawn up in accordance with the requirements of GOST 7.0.100-2018 [2]. It is permissible to use GOST 7.1-2003.

The presented selection of publications clearly demonstrates the moment of optimization of the methodological work of college teachers, assistance from the directors in organizing methodological search.

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Аннотация. В статье рассмотрены вопросы оптимизации методической деятельности преподавателя профессиональной школы. Раскрыто участие руководства учебного заведения в оказании помощи преподавателям в их методическом поиске. Представлена подборка изданий для преподавателей Севастопольского промышленно-технологического колледжа.

Ключевые слова: методический продукт, профессиональная школа, подборка изданий, оптимизация, Севастопольский промышленно-технологический колледж.

Annotation. The article deals with the optimization of the methodological activity of a teacher of a professional school. Disclosed is the participation of the leadership of the educational institution in helping teachers in their methodological search. A selection of publications for teachers of the Sevastopol Industrial and Technological College is presented.

Keywords: methodical product, professional school, selection of publications, optimization, Sevastopol Industrial and Technological college.

COMPARATIVE ANALYSIS OF EDUCATIONAL SYSTEMS IN RUSSIA AND LEADING EUROPEAN COUNTRIES

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Security and economic well-being are largely determined by the level of education of the nation for only professionals capable of competently performing their duties can provide a foundation and well-being for their country. Educational systems in different countries are constantly modernized, and bring something unique to global trends.

In the context of the Bologna process and the information society, professionalism is ensured by the integration of domestic and foreign experience in the field of education. In this regard, it becomes necessary to search for optimal ways to train future specialists on the basis of a comparative pedagogical analysis. Comparative pedagogy as a branch of pedagogical science studies in a comparative way the state, patterns and trends in the development of theory and practice in different countries, as well as the ratio of general trends, national and regional specifics.

The purpose of this comparison is the mutual enrichment of national education systems through the use of positive foreign experience. For example, Soviet education is widely believed to be one of the best in the world. In reality, however, the Soviet system had its drawbacks, which can

be identified in the course of a comparative pedagogical analysis, and not reproduced in the future.

Russian universities are constantly improving their positions in international rankings, which is associated with the tendency to familiarize domestic education with international formats. One of the most important tasks of democratizing education in Russia is to overcome the country's gap in the context of world trends in economic and social development. Another urgent task is to improve the quality of education and search for its optimal content. At the same time, in a rapidly changing labor market, the education system is focused on teaching people throughout their lives.

Scientists-educators B.L. Wolfson and Z.A. Malkov substantiate current trends in education by the following factors:

- increasing intellectualization and dynamism of labor;

- the paramount importance of the human factor;

- wide dissemination of the ideas of democratization of the social life of society;

- demographic changes;

- the emergence and widespread dissemination of new information technologies [1].

The study of the experience of a number of leading universities in foreign countries shows that not only the level of education, but also the development of the need for creativity, self-realization and self-actualization of the majority of university graduates, whose constituent characteristics are modern knowledge, information, new technological norms, values, intelligence, etc.

According to a study by the United Nations Development Program, Australia, Denmark and Finland occupy the leading positions in the education level index [2]. Such an index measures the achievements of a country in terms of the achieved level of education of its population in two main indicators: the adult literacy index and the index of the cumulative share of students in primary, secondary and higher education.

Literacy data are obtained from official sources based on national censuses and is compared with indicators calculated by the UNESCO Institute for Statistics. Data on the number of citizens from educational institutions are analyzed by the UNESCO Institute for Statistics on the basis of information provided by the relevant educational institutions around the world.

Before proceeding with the analysis of the leading educational systems of European countries, we can state the main features inherent in education in the Russian Federation, where all citizens of the country are guaranteed

the opportunity to receive education, regardless of nationality, social status and religion.

Preschool education provides for the upbringing of children 2-7 years old. Children aged 6-7 begin their education in primary school, where they study for 3-4 years, then go to secondary school. Graduates of the 9th grade can continue their education at school, or go to college or technical school. A certificate of complete secondary education is issued at the end of the 11th grade and passing the final exams. Having a certificate of complete secondary education and successfully passed exams allow you to continue your education in universities [3].

In Russia, the share of spending on education is underestimated. In terms of average values of the share of spending on education, it loses compared with the leading countries. At the same time, an orientation was given to the importance of the senior stage of school education, the task of which is to ensure the admission of graduates to the university. Note that the teaching profession has ceased to be prestigious; it has low indicators in terms of comparison of professions in Russia [4].

One should consider education system in the Finland. Schooling begins at the age of 7. All children, including citizens of other countries, are required by law to acquire knowledge at the nine-year school level. Particular attention is paid to the knowledge and skills required in everyday life. Graduates of a general education school are not issued a diploma or a certificate of secondary education, but they receive the right to enter any educational institution of the second stage after passing the final exams. The profession of a teacher is one of the most prestigious in Finland, because of its popularity it is second only to the professions of a doctor and a firefighter, while the highest requirements are imposed on the teacher.

The Finnish school system is based on a culture of trust and not on the traditional principle of control. There students are taught the ability to think independently and critically when solving problems. Teachers develop their research and creative skills, teach them to evaluate their own work and their achievements. In this respect, the Finnish education system has more advantages than the Russian one. Finland is constantly improving the education system in order to bring it to a higher level.

Higher education in Finland, as well as in Russia, is based on the model of the Bologna process [5]. The required quality of higher education is ensured by the mobility of students, teachers and researchers.

The next country for comparative analysis is Denmark. It is a country of almost universal literacy. All children are obliged to attend general education schools for 9 years. The admission of school graduates to gymnasiums and then to universities depends on the results of competitive

exams. Danish folk schools for adults are well known, in which persons over 18 years of age study. They live in schools and take up to 40 weeks of training. After graduation from such schools, no exams are held and no certificates are issued. Public schools began to be created in the middle of the 19th century in rural areas for young farmers. However, many schools are in cities from the twentieth century [6].

"Prestige is nothing, benefit and well-being are everything". This phrase shows the principle of Danish higher education. It is important for Danish universities to provide students with a practical, job-marketable education that will contribute to personal and social prosperity. There is simply no such thing as a broad and versatile university education in Denmark. The state supports the development of the most promising specialties for the country.

In general, the advantage of foreign educational institutions over Russian is manifested in the attitude to the student as an equal partner, and not a subordinate and dependent being, who must acquire knowledge. Studying at foreign universities is, first of all, promising from the point of view of self-determination and development of the inclinations and abilities of students. In addition, they tend to train practitioners, not theorists in the West, so graduates know exactly how, when and where they can use the knowledge gained. Scientific bases, laboratories and libraries open up opportunities for professional self-improvement and scientific work.

Thus, each of the considered educational systems is unique. Positive foreign experience can serve as a basis for further improvement of education in the Russian Federation and advanced training of university graduates.

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Аннотация. В статье представлен сравнительный анализ образовательных систем Российской Федерации, Финляндии и Дании в аспектах финансирования, основных приоритетов и тенденций развития. Раскрыто значение сравнительной педагогики в условиях Болонского процесса. Рассмотрена статистика ЮНЕСКО.

Ключевые слова: образовательные системы, Российская Федерация, Финляндия, Дания, ЮНЕСКО

Annotation. The article presents a comparative analysis of the educational systems of the Russian Federation, Finland and Denmark in terms of financing, main priorities and development trends. The significance of comparative pedagogy in the context of the Bologna process is revealed. Considered UNESCO statistics.

Key words: educational systems, Russian Federation, Finland, Denmark, UNESCO.

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TEACHING MARITIME CADETS TO GRAMMAR RULES BY MEANS OF CONTEXTUAL LEARNING

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Marine English teaching requires nowadays a thoroughly elaborated approach and pedagogical technology which facilitates developing readiness of maritime cadets for profession-oriented English language communication. For the last decades language education theorists, psychologists and researchers sought to devise a method for teaching foreign languages that would guarantee successful learning.

Several methods were developed, some of which became the established mode of thinking for several years. During the 1960s and '70s, the ***Audiolingual method*** became popular, its legacy being the widespread use of language laboratories worldwide. Central to the techniques of Audiolingualism was the behaviourist belief that, via the 'stimulus and response' concept, learners could be trained to speak English correctly by first listening and then responding to units of language presented in

carefully graded sequence [3]. Although aspects of Audiolingualism have been carried through to the Communicative Approach, it is now recognized that teaching needs to incorporate a broader and more realistic view of language use and language learning, views which have emerged from research into second language acquisition.

This research has exposed the limitations of the Audiolingual method; however, it is important to recognize why this method gained currency during the 1960s and '70s. Audiolingualism itself was a reaction to the traditional practice of foreign language teaching which was based on techniques for teaching the ancient classic languages of Latin and Greek. Because students of these languages were required to read rather than speak, learning was traditionally based on analysing and memorizing structure for the purposes of translation. This system was known as the ***Grammar Translation method***, and although it may have worked well for classics scholars, it cannot cater adequately for those who need to be able to speak in foreign languages today [2].

Many other methods emerged from the 1960s onwards, among them Situational Language Teaching, The Silent Way, Suggestopedia and the Natural Approach. Each attempted to pinpoint 'the right way' to teach languages and although each method has merits and has furthered the debate, none can be said to provide the definitive solution.

The objective of this manuscript is to analyze the advantages of contextual learning technology developed by A.A. Verbitskii as the basis for developing readiness of maritime cadets for profession-oriented English language communication in general and teaching grammar rules in particular to initiate their application by marine college graduates in their future profession-oriented communication.

Means of contextual learning encourage incorporating grammar with language function helping cadets to recognize the communicative purpose of the target language. Being a basic unit contextual learning [1], a context or setting which is clear and familiar presents a grammar rule making it easier for cadets to grasp the meaning of an abstract structure.This is especially important if English structure is conceptually different to the students' first language.

Onetechnique is to present students with a text that contains the new language. The text maybe specially written as a model for presenting the new structure or may be a more authentictext in which the new structure appears incidentally. In model texts, the language surroundingthe new structure is generally simplified with the distracting elements of 'real' communicationremoved, making them suitable for elementary level

students. Authentic texts which presentthe new item in a more natural context are more appropriate for intermediate students.

Dialogues are useful for presenting new language in that theyare a simple way of showing how the target structure is introduced and respondedto. Two speakers are adequate for presentation dialogues: any more is likely toconfuse the students. Establish or elicit the background situation first by showingthe students a picture relating to the dialogue or byexplaining who the characters are, where they are and why they are talking,without revealing too much of the content.

A context can be otherwise created by a short listening text that contains the targetstructure. First, do a pre- and a gist-listening activity to familiarize the studentswith the topic and the content of the text. Thenfocus the students' attention on the new input by asking students to listen carefullyto that part of the listening text. Pause the cassette after the new item and modelit by repeating it or by writing it on the board followed by some concept questions.

Visuals are an alternative to the context formed by texts. Visuals do not have to be restricted to present tenses: indicatethe time of day and the date above the pictures to adapt the context to the pastor future. Cartoon strips or picture sequences are good for modelling a newstructure in the context of a narrative. Action picturescan be used to present thelanguage of description or to comment on what people are doing (useful forpresenting continuous tenses). Single item picturesand everyday objects (often called realia) are useful for teaching comparatives and superlatives as well asadjectives, among other structures. Teach passive forms or conjunctions throughdiagrams or technical illustrations. Drawing figures, even if they are very basic,is one of the most versatile techniques as you can build up or elicit a situation thatconcerns the character(s), manipulating the situation to practise the target language or function.

The internet is now the richest and quickest source of pictures andphotographs. Most search engines have an 'Images' option. Simply use this tool as you would if you were searchingfor information on the web; choose the picture you require from those availableand copy and paste into the programme you are using. If possible the languagetrainer could use an Overhead Projector to show the images, or even take a laptopcomputer into the classroom and project the pictures onto a screen. Microsoft Power Point is ideal for this purpose but any desk top publishing programme can work very well.

A context can be created for the new language either by asking studentsabout their own experiences of, or knowledge about, a specific topic. For example,introduce the structure 'Have you ever been to…?' by

using it to ask the studentswhich countries they have been to. They don't need to know the complete structureto understand the question at this stage. Alternatively, use your own experiencesas the introductory context.

After introducing the new structure to the students, it is vital tocheck that the students have understood the idea that the structure communicatesby asking a series of concept questions. These questionsrequire only simple answers that can be easily found in the context. It is notnecessary for the students to produce the full correct form at this stage.

After this 'lead in' and initial listening, reading or discussion relating to the meaning of thenew input, highlight the form of the new structure. The aim of this part of the presentation isto familiarize the students with the form, spelling and sounds and to give strictly controlledpractice in producing the target structure accurately. After the presentation, the students willbe ready for some less controlled practice of the structure.

The technology of contextual learning is rich in means of both introducing, drilling, memorization and application of grammar rules grammar structures employing a variety of contexts relating the studying process to the future profession-oriented communication of maritime college cadets. Implementation of contextual learning technique into teaching grammar provides a shift from 'knowing about grammar' to understanding the meaning as well as theform of grammar items, in order to be able to use the structure in communication. In thisway, students develop a 'global' sense of context along with the ability to manipulate thestructure in detail.

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Аннотация. Актуальность данного исследования обусловлена необходимостью поиска и обоснования новых подходов к обучению грамматике английского языка будущих специалистов морских вузов для обеспечения осознанного использования ее в процессе будущей профессионально-ориентированно коммуникации на английском языке. Цель данной статьи заключается в анализе преимуществ средств контекстного обучения при введении и отработке грамматических конструкций.

Ключевые слова: профессионально-ориентированная коммуникация, контекстное обучения, грамматика, контекст.

Annotation. The relevance of this study is due to the need to search for and substantiate new approaches to teaching English grammar to maritime college cadets in order to ensure its conscious use in the process of future professionally oriented communication in English. The objective of this article is to analyze the benefits of contextual learning tools for introducing and practicing grammatical structures.

Key words: professionally oriented communication, contextual learning, grammar, context.

UDC 004
THE INFLUENCE OF MODERN INFORMATION TECHNOLOGIES ON THE PROCESS OF LEARNING A FOREIGN LANGUAGE

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In the context of the coronavirus pandemic, the relevance and necessity of digital technologies have been revealed. The forced discontinuation of the usual ways of working has shown the importance of alternative approaches, such as working or learning at home through online services, which have begun to affect more areas of human activity, including education. Due to the globalization of the Internet, each industry has the opportunity to transfer its activities to a remote format, including education. Also, to date, each area of study requires knowledge of foreign languages. Because of this need, the services for studying them are much better developed than for other educational areas. Consider the impact and effectiveness of innovative technologies in the field of education on the examples described below.

There is a large number of services for learning English, rather than other languages. They set the trends in teaching methods, and therefore, we will focus on them in the analysis. These services share some common features.

Word learning

If we talk about language learning, then words are the foundation that is used for this. Many people are used to learning words from cards written by hand or by translation. But as progress progresses, new technologies are emerging, even for such mundane things. So, many services already have the ability to learn words in such formats as: associative memorization [1], game-learning and timer notification. There are a lot of applications or services whose main purpose is to learn words, but Quizlet can be singled out separately [2]. This service is very easy to learn and flexible to use, a wide range of functionality will allow you to choose the best format for both the teacher and the student, since this service can not only create lists of words, but also share them, as well as watch the progress of other users.

Game-education

It is no secret that spending a lot of time and effort on training is always tiring. Therefore, you need to properly relax not only interesting, but also with benefit. So, you can compete in the knowledge of a foreign language with other users, which will favorably affect the assimilation of new material, and repeating the old one will never hurt. Applications that can be attributed to this category are Quiz your English [3], Duolingo [4] and 3000 Words [5].

The result of social networks and smart people

What will happen if you combine social networks and learning foreign languages? This question was asked by the programmers of the company Tripod Technology GmbH and created Tandem [6]. The cardinal advantage of such applications is the combination of acquired knowledge in the field of foreign languages and ordinary everyday communication. After all, there are often cases when we can learn some aspects of the language direction to automatism, pass all the tests and tests perfectly, but experience difficulty in live communication.

Professional online schools

Of course, continuous self-training and improvement of skills are necessary, but the help of a professional specialist is also important. There are a large number of online schools, such as Skyeng [7], Englex [8], and EnglishDom [9]. These services offer a wide range of training programs focused on your goals, level of knowledge and convenience, working with an experienced personal teacher, not only Russian-speaking, but also native speakers. This approach to learning will allow you to develop habits and practice regularly, doing homework.

Thus, at the moment, modern technologies allow you to take lessons most effectively and comfortably, thanks to a combination of approaches. These innovations have simplified and made available the learning routine, increasing people's interest in self-education, making this process more

interactive. Thanks to the globalization of the Internet, almost everyone can try out these methods. There is a huge variety of ways to acquire knowledge of a foreign language, but you should not stop at a certain choice and look for a universal way for each need.

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Аннотация. В данной статье рассматриваются инновационные технические методы обучения, а именно изучение иностранных языков с использованием онлайн-сервисов и мобильных приложений. Проведен анализ учебного процесса с использованием интернет-приложений. Рассмотрены примеры таких ресурсов, их преимущества, эффективность и гибкость. Показывается группировка по их типажу. Представлены выводы, основанные на результатах проведенного исследования. Предложены рекомендации по рассмотренным подходам. Подчеркиваются их преимущества.

Ключевые слова: образование, иностранный язык, смарт-технологии, онлайн-сервисы, мобильные приложения.

Annotation. This article discusses innovative technical methods of teaching, namely the study of foreign languages using online services and

mobile applications. The analysis of the educational process using Internet applications is carried out. Examples of such resources, their advantages, efficiency and flexibility are considered. The grouping by their type is shown. Conclusions based on the results of the study are presented. Recommendations on the considered approaches are offered. Their advantages are emphasized.

Keywords: education, foreign language, smart-technologies, online services, mobile applications.

STUDENTS' POINT OF VIEW ON THE ORTHODOX COLLEGE AS A CENTER FOR PERSON'S SPIRITUAL AND MORAL EDUCATION

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In the process of studying "Pedagogy" discipline, it is advisable for students to provide an opportunity for research activities based on scientific works, empirical methods and personal experience. This approach provides personality-oriented and practice-oriented education, allows to reveal and direct the student's professional interest, enrich his ideas about his place in the future of the profession.

The methods aimed at self-expression of students and their assessment of various pedagogical situations, problems, tendencies are especially valuable. In our opinion, one of the most effective methods of self-expression, is an essay (translated from French "reflection") as a short, well-reasoned presentation of one's own point of view on an urgent problem. The essay defense on pedagogical problems in a practical lesson in the discipline contributes to the mutual enrichment of the students of the group, the organization of a constructive discussion.

One should give an example the student essay of A.O. Kakotkina.

"At the present stage of Russian education, there is a process of convergence between science and religion in the upbringing of the individual. The main task of upbringing is the formation of an integral and comprehensively developed personality, in which spirituality and morality

play the role of a foundation. It should be noted that educational institutions mainly form an intellectually developed personality, omitting spiritual development. Therefore, Orthodox gymnasiums are a vital element of the educational system, which can form not only an intellectual, but also a spiritual and moral personality[1, p. 79].

In recent decades, much attention has been paid to Orthodox education in Russia, and more and more parents are sending their children to Orthodox grammar schools. My mother, on the recommendation and blessing of her spiritual father, sent my younger brother to the Varnitsa gymnasium for boys. This is a closed boarding school for schoolchildren in grades 10-11.

Education and upbringing in such gymnasiums is based on an Orthodox foundation. This applies to all subjects, not just those that are not available in a regular school. "A solid Orthodox foundation" does not mean, of course, that children are taught some special Orthodox chemistry, church algebra or monastic physical education.

The point is that the very process of teaching, the relationship between teachers and students organically follows from the fact that they are Orthodox Christians. In addition to the subjects of the school curriculum, ancient Greek and Latin languages are studied, which form the basis of Christian European culture. The gymnasium choir, performing both church and secular classics, singing and sports, pilgrimage trips and meeting interesting people, contribute to the comprehensive development of the personality. Particular attention is paid to primary theological education - the study of Holy Scripture, worship and church history.

I took a short interview with my brother and found out that his gymnasium has its own rules, albeit not particularly monastic ones. For example, you cannot leave the territory without the consent of the senior educator (educators are either teachers or priests who are on duty every day and keep order). You cannot use a computer outside of school hours and, of course, all kinds of game consoles. Wake up and hang up is on schedule, lunch is on schedule, as well as prayer.

Someone might say that all these are problems and troubles for students. But, in our opinion, it is through such restrictions and orders that the upbringing of the individual takes place. This is upbringing in terms of directed instruction in Orthodox norms, certain orders, and a way of thinking. Of course, there were cases when those who entered the gymnasium were not ready for such an order, they believed that monastic life was not for them, and left.

There were also those who generally adopted a new way of life, but sometimes acted in their own way. And this is normally, because all people

are different. However, this does not mean that they acted somehow hypocritically, no. Life for them in an Orthodox gymnasium was a plus, because the main thing in these statutes is not their blind execution, but the result, i.e. moral formation and strengthening. People who did not act according to the charter understood that they were wrong and subsequently corrected themselves. Those who allegedly adopted a new way of life, but in fact stubbornly disagreed with the new rules, subsequently somehow themselves were eliminated - either because of incidents or by their own decision.

After studying at the gymnasium, people change, acquire new qualities, rethink something and accordingly organize relations with people.

But the most important thing is the atmosphere that is cultivated here has the following features: respect for the personality of the student, friendship between teachers and students, care of the elders for the younger ones. Employment of students is an important aspect in spiritual and moral education. With a properly allocated time, high school students have no time to get bored and think about nonsense.

They do not watch TV, because it is not there, and they do not play computer games, because the computer is used in classrooms for educational purposes only. And when there are only three hours of personal time at their disposal, and there is no computer at hand, the students of the gymnasium replace it with live communication, board games or sports. This improves academic performance and helps you get rid of addictions. After all, you cannot leave the territory of the gymnasium, but there are no shops. In my opinion, the most terrible addiction of modern youth is not alcohol or cigarettes at all, but it is a computer games, televisions, phones and tablets.

In the modern world, a new kind of person has appeared - homo medium - one with a nervous system, a person of mental decay, who cannot set the boundaries and filter of external information and assimilates it in its new form.

Each person, according to the teachings of the Holy Fathers, is a small world. Each person is a unique individuality. And "the media space depersonalizes people, so they have become similar to each other, but resembling not in the unity of love for each other, but in the unity of monotony" [3, p. 165].

Modern parents do not have the opportunity to confine their child in a deaf tower in order to completely isolate him/her from the soul-damaging influences of the world. This would be a manifestation of too unreasonable parental love. Reasonable love is humble and knows that not everything can be done. But "the impossible by man is possible for God". Therefore, the

primary duty of Christian parents at all times is to pray for their children. It is also the basis of all family education" [2, p. 48].

The presented example of a student essay clearly demonstrates the advantages of this method in diagnosing the orientation of a student's personality, his/her priorities and assessments, which can serve as a basis for building a further learning path.

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Аннотация. В статье раскрыто значение метода эссе для диагностики направленности личности студента. Представлено студенческое эссе, посвященное оценке духовно-нравственного воспитания в условиях православной гимназии. Описаны результаты интервьюирования воспитанника гимназии. Показана роль самовыражения в учебной деятельности студентов.

Ключевые слова: эссе, самовыражение, студент, православная гимназия, духовно-нравственное воспитание.

Annotation. The article reveals the importance of the essay method for diagnosing the orientation of the student's personality. A student's essay devoted to the spiritual and moral education evaluation in the conditions of an Orthodox gymnasium is presented. The results of interview of gymnasium student are described. The role of self-expression in students ' learning activities is shown.

Keyword: essay, self-expression, student, Orthodox gymnasium, spiritual and moral education.

EMPATHY AS A FACTOR OF UNIVERSITY STUDENTS' TOLERANCE

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The term "tolerance" is actively discussed in cultural studies, sociology, political science, economics, psychology, history, pedagogy. The increased interest in tolerance is due not only to its scientific interdisciplinarity, but also to social practice needs, on the one hand, actively developing in the context of political modernization, on the other hand, generating new social processes and events that both contribute to an increase in tolerance, and at the same time provoke different the nature of the manifestation of tolerance [1, 2].

We are interested in the topic "Empathy as a factor of tolerance among students at a university". The problem of increasing the role of empathy has long been the subject of scientific research in psychology. This is due to the fact that empathy as a psychological phenomenon has a significant impact on the entire personality as a whole, increases the motivation and productivity of activity and expands the idea of its effectiveness.

The purpose of the article is to study empathy as a factor of tolerance among students at a university.

The research hypothesis is in the following: it is assumed that the features of empathy affect the propensity for tolerance among students at the university.

Empirical methods: express questionnaire "Index of Tolerance" (G.U. Soldatova, O.E. Khukhlaev, L.A. Shaigerova) and V.V. Boyko "Diagnostics of the level of empathy".

The study was carried out on the basis of the Sevastopol Institute of Economics and Humanities (branch) of the Federal State Autonomous Educational Institution of Higher Education "CFU named after V.I. Vernadsky". The study involved 16 people, including 2 boys, 14 girls, aged 18-20 years.

One should consider the results of a study on the empathy diagnostics technique - the technique of V.V. Boyko "Diagnostics of the level of empathy". Visually generalized results are presented in the form of a figure1.
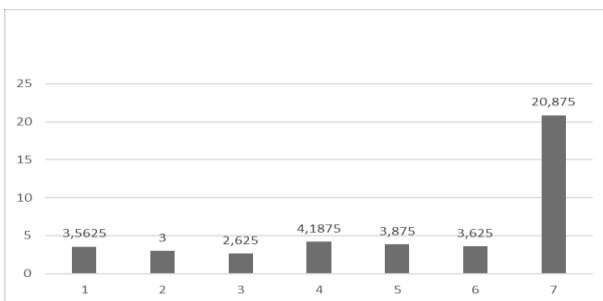
Figure 1 – General results of the empathy study (comparison of the average indicators by scales)

Note to Figure 1:
Scale designations:
1 - a rational channel of empathy; 2 - emotional channel of empathy
3 - an intuitive channel of empathy; 4 - attitudes that promote empathy
5 - penetrating ability in empathy; 6 - identification in empathy
7 - general level of empathy

According to Figure 1, students have more pronounced attitudes that promote empathy (4.2 - above average). Empathy attitudes facilitate the operation of all empathic channels. The respondents have a high range of emotional responsiveness and empathic perception. Various channels of student empathy act more actively and reliably, without encountering obstacles on the part of personality attitudes

The majority of students have above average scores in penetrating ability in empathy (3.9 - above average). The penetrating ability in empathy allows to create an atmosphere of openness, trust, sincerity, which contributes to disclosure and empathic comprehension.

Identification in empathy is also expressed above average (3.6). It is the ability to understand another based on empathy, putting oneself in the shoes of a partner. Identification is based on ease, mobility and flexibility of emotions, the ability to imitate.

The rational source of empathy is also expressed above average (3.5). It characterizes the focus of attention, perception and thinking of the empathizing person on the essence of any other person - on his condition, problems, behavior. It is a spontaneous interest in the other that opens the partner's emotional and intuitive reflection. In the rational component of empathy, one should not look for logic or motivation for interest in another. The partner attracts attention with ones beingness, which allows the empathizing person to identify his/her essence.

The emotional pass of empathy is moderately expressed (3). It captures the ability of the empathizing person to enter into emotional

resonance with others - to empathize, to participate.

The intuitive channel of empathy is below average (2.6). The point score indicates the respondent's ability to see the behavior of partners, to act in conditions of a deficit of initial information about them, relying on the experience stored in the subconscious.

The general level of empathy among students is predominantly at an average level (20).

One should consider the generalized results of the diagnosis of tolerance according to the express questionnaire "Index of Tolerance" (G.U. Soldatova, O.A. Kravtsova, O.E. Khukhlaev, L.A. Shaigerova).
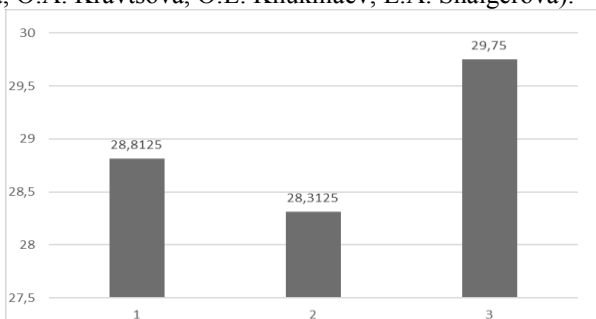
Figure 2 – Generalized results of the study of tolerance (comparison of average indicators by scales)

Note to Figure 2:
Scale designations:
1 - ethnic tolerance
2 - social tolerance
3 - tolerance as a personality ability.

Ethnic tolerance shows the attitude of students towards representatives of other ethnic groups and attitudes in the field of intercultural interaction. It has a high level (29).

Social tolerance makes it possible to identify tolerant and intolerant manifestations of students in relation to various social groups (minorities, criminals, mentally ill people), as well as to study personality attitudes in relation to certain social processes. It is expressed moderately (28).

As a personality ability includes items that diagnose it, attitudes and beliefs that largely determine ones of the subjects to the world around them. It has a high level (30).

To prove the hypothesis of our work that the features of empathy affect the propensity for tolerance among students at the university, the Spearman correlation coefficient was calculated.

Table 1. Empirical values Spearman's correlation coefficient between empathy and tolerance

Empathy	Tolerance		
	Ethnic tolerance	Social tolerance	Tolerance as a personality ability
Rational indicator of empathy	-0.032	0.044	-0.026
Emotional Empathy indicator	0.2	0.353	0.154
Intuitive indicator of empathy	-0.239	-0.204	0.438
Attitudes that promote empathy	0.31	0.317	0.371
Penetrating ability in empathy	-0.005	-0.04	-0.038
Identification in empathy	0.451	**0.587**	0.085
General level of empathy	0.254	0.371	0.342

The hypothesis is partially proven. The existence of a relationship between identification in empathy and social tolerance has been proven (r=0.6, while p ≤0.05).

Conclusion. Thus, according to the results of the study, it can be concluded that it is necessary to develop the empathic abilities of students, which provide an increase in social tolerance.

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Аннотация. В рамках исследования доказана наличие взаимосвязи между идентификацией в эмпатии и социальной толерантностью (r=0.6, при p ≤0.05). По результатам исследования можно сделать вывод о том, что необходимо развивать эмпатические способности обучающихся, что будет способствовать повышению социальной толерантности.

Ключевые слова: эмпатические способности, социальная толерантность, студент вуза.

Annotation. The study proved the existence of a relationship between identification in empathy and social tolerance (r=0.6, at p ≤0.05). According to the results of the study, it can be concluded that it is necessary to develop the empathic abilities of students, which will contribute to increasing social tolerance.

Key words: empathic abilities, social tolerance, university student.

SPECIFICITY OF COPING STRATEGIES AND BEHAVIORAL RESPONSES TO PANDEMIC IN ENLISTED PERSONNEL

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Introduction. Studies of adaptation processes to the conditions of conscription in the Armed Forces of the Russian Federation are the most important ones. The adaptive resources of each person vary individually, therefore, if the adaptive capabilities necessary for optimal balance with the environment are exceeded, the servicemen experience misadaptation.

The adaptation of enlisted personnel to military service is a complex process of restructuring existing skills, abilities and habits in accordance with new tasks, goals, expectations and conditions for their implementation. It is on the adaptation of enlisted personnel that their behavior, the presence of internal psychological comfort, and optimal interaction with the environment will depend.

The need to adapt to the conditions of enlisting makes special requirements for coping strategies in a changing social, socio-psychological situation, and in this regard, the study of coping strategies of military

personnel in connection with adaptation to a new environment is relevant and timely [1, 2, 3, 4].

The purpose of the empirical study is to research an adaptation process, coping strategies and behavioral responses to a pandemic in enlisted personnel.

Materials and methods are personality questionnaire "Adaptability – 1" (A.G. Maklakov, S.V. Chermyanin); questionnaire "Methods of coping behavior" (R. Lazarus); the questionnaire "Behavioral reactions to a pandemic (T.D. Dubovitskaya, A.V. Shashkov) and Spearman's rank correlation coefficient.

Experimental base of the study was carried out on the basis of the military unit 63876 in Sevastopol during 2021. It was attended by 30 conscripts. The average age of the respondents is 21 years.

According to the results of the multilevel personal questionnaire "Adaptability – 1" (A.G. Maklakov, S.V. Chermyanin), one can see the general dynamics of enlisted personnel in terms of adaptive capabilities based on an assessment of some psycho-physiological and socio-psychological characteristics reflecting the integral features of mental and social development (see Fig. 1).

Figure 1 – Average values for the diagnosis of MLO "Adaptability – 1"

According to Figure 1, it can be noted that in conscripts, behavioral regulation, communication potential, moral state, personal adaptive potential, asthenic reactions and states, psychotic reactions and states, maladaptive disorders are at an average level (from 4.6 to 5.1) . Communication skills are of middle level. Enlisted personnel quickly established contacts with others, they are non-conflict. Also, an orientation towards adherence to generally accepted norms of behavior was well developed.

According to the results of the questionnaire "Methods of coping behavior" (R. Lazarus), one can see the general values of coping strategies that are used by conscripts in difficult situations (see Fig. 2).

Figure 2 – Average values for the diagnosis "Methods of coping behavior" (R. Lazarus test)

According to Figure 2, it can be noted that conscripts choose such coping strategies as: confrontation, distancing, escape-avoidance, positive overestimation very rarely (values less than 40), and coping strategies: self-control, seeking social support, taking responsibility and planning a solution to a problem - almost constantly (values between 40 and 60).

This means that enlisted personnel makes attempts to overcome negative experiences in relation to the problem by consciously suppressing and restraining emotions, reducing their influence on assessing the situation and choosing a strategy of behavior, high control of behavior, and striving for self-control. Also, servicemen solve problems by attracting external resources (social), seeking information, emotional support. They are characterized by an emphasis on interacting with others, expecting attention, advice and sympathy.

Enlisted personnel recognizes the problem and responsibility for solving it, overcome it by purposefully analyzing the situation and possible options for behavior, developing a strategy for solving the problem, planning their actions taking into account objective circumstances, past experience and available resources in some cases with a distinct element of self-criticism and self-accusation.

According to the results of the questionnaire "Behavioral reactions to a pandemic" (T.D. Dubovitskaya, A.V. Shashkov), one can see the general values of the reactions of them (see Fig. 3).

According to Figure 3, it can be noted that among the conscripts on the scale, bargaining (2.6) and protest (3.2) are at a low level. This suggests that the military does not experience negative reactions in relation to the pandemic.
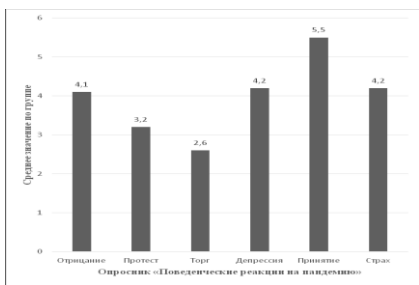
Figure 3 – Average values according to the questionnaire "Behavioral responses to a pandemic".

Such scales as denial (4.1), depression (4.2) and fear (4.2) are at the middle level. These results indicate that military personnel are slightly prone to depression and to a small extent there is fear and denial. This may be due to the fact that during the pandemic the servicemen were "cut off" from the outside world and were constantly in contact with the same people.

The scale has a high value - acceptance (5.5). This suggests that the servicemen have come to terms with this situation and are trying not to get depressed.

According to the hypothesis, it was highlighted that depending on the choice of coping strategies, the level of adaptation and behavioral response to the pandemic will change. A correlation matrix was built and the following correlations were obtained (while $p \leq 0.05$):

– a strong negative relationship between the component of adaptation "Behavioral regulation" and the following coping - strategies "Confrontation" ($r = -0.8$), "Distance" ($r = -0.81$) and self-control ($r = -0.76$), that is, these coping strategies carry a negative side and prevent servicemen from increasing their adaptive potential;

– a strong negative relationship between the adaptation component "Communication potential" and the following coping strategies "Confrontation" ($r = -0.7$), "Distance" ($r = -0.7$) and self-control ($r = -0.7$), that is, these coping strategies carry communicative threats that prevent a young fighter from creating a constructive communication situation;

– a strong negative relationship between the adaptation component "Personal adaptive potential" and the following coping strategies "Confrontation" ($r = -0.7$), "Distance" ($r = -0.7$) and "Self-control" ($r = -0.7$), that is, these coping strategies negatively affect the potential of the individual and his internal resources;

- a strong negative relationship between "Maladaptive disorders" and the following coping strategies "Confrontation" ($r = -0.8$), "Distance" ($r = -$

0.8) and self-control (r = -0.6), that is, data coping strategies affect the level of mental disorder of a soldier's personality.

If we state how much the level of adaptation affects the type of behavioral response to a pandemic, then only a tendency towards correlation was revealed here:

– a tendency towards a correlation between "Behavioral regulation" and the type of behavioral response to a pandemic "Denial" (r = -0.2): the higher the behavioral regulation, the lower the indicators of denial of the pandemic as such, and vice versa;

– also, the behavioral response to the pandemic "Denial" is inversely correlated with such adaptation components as "Communication potential" (r = -0.31) and "Asthenic reactions and states" (r = -0.3), that is, not knowing what a pandemic is leads to a denial of this global problem, and this reaction is formed among those respondents who do not deny the pandemic.

Discussion and Conclusions. Thus, the hypothesis of the study was partially proven, since not every variable of adaptability is interconnected with the coping strategies of enlisted personnel. There was also a tendency towards a correlation between adaptability and the type of behavioral response to a pandemic, in particular to the type of behavioral response "Denial".

It can be stated that the type of coping strategies is included in the system of the adaptive potential of the enlisted personnel. It was proved that the type of coping strategies is not always constructive in nature and forms not only the variability of the conscious actions of a young person, but to a greater extent bears an unconscious protective character.

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Аннотация. В статье представлены результаты эмпирического исследования взаимосвязи адаптационного потенциала военнослужащих срочной службы с копинг-стратегиями, а также типами поведенческих реакций на пандемию. Гипотеза исследования была частично доказано, так как не каждая переменная адаптивности взаимосвязана с копинг-стратегиями военнослужащих. Также была выявлена тенденция к корреляции между адаптивностью и типом поведенческой реакции на пандемию, в частности на тип поведенческой реакции «Отрицание».

Ключевые слова: военнослужащий срочной службы; адапация, нервно-психическая устойчивость, корреляция, личностный адаптационный потенциал, пандемия, тип реакции.

Annotation. The article presents the results of an empirical study of the relationship between the adaptive potential of enlisted personnel and coping strategies, as well as types of behavioral responses to a pandemic. The hypothesis of the study was partially proven, since not every variable of adaptability is correlated with coping strategies of enlisted personnel. There was also a tendency towards a correlation between adaptability and the type of behavioral response to a pandemic, in particular to the type of behavioral response "Denial".

Keywords: enlisted personnel, adaptation, neuropsychic stability, correlation, personal adaptive potential, pandemic, type of reaction

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STRATEGIES AND BEHAVIORAL RESPONSE PECULIARITIES TO PANDEMIC IN ENLISTED PERSONNEL

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Introduction. Studies of adaptation processes to the conditions of conscription in the Armed Forces of the Russian Federation are the most important ones. The adaptive resources of each person vary individually, therefore, if the adaptive capabilities necessary for optimal balance with the environment are exceeded, the servicemen experience misadaptation.

The adaptation of enlisted personnel to military service is a complex process of restructuring existing skills, abilities and habits in accordance with new tasks, goals, expectations and conditions for their implementation. It is on the adaptation of enlisted personnel that their behavior, the presence of internal psychological comfort, and optimal interaction with the environment will depend.

The need to adapt to the conditions of enlisting makes special requirements for coping strategies in a changing social, socio-psychological situation, and in this regard, the study of coping strategies of military personnel in connection with adaptation to a new environment is relevant and timely [1, 2, 3, 4].

The purpose of the empirical study is to research an adaptation process, coping strategies and behavioral responses to a pandemic in enlisted personnel.

Materials and methods are personality questionnaire "Adaptability – 1" (A.G. Maklakov, S.V. Chermyanin); questionnaire "Methods of coping behavior" (R. Lazarus); the questionnaire "Behavioral reactions to a

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Figure 1 – Values for the diagnosis of MLO "Adaptability – 1"

According to Figure 1, it can be noted that in conscripts, behavioral regulation, communication potential, moral state, personal adaptive potential, asthenic reactions and states, psychotic reactions and states, maladaptive disorders are at an average level (from 4.6 to 5.1) . Communication skills are of middle level. Enlisted personnel quickly established contacts with others, they are non-conflict. Also, an orientation towards adherence to generally accepted norms of behavior was well developed.

According to the results of the questionnaire "Methods of coping behavior" (R. Lazarus), one can see the general values of coping strategies that are used by conscripts in difficult situations (see Fig. 2).

Figure 2 - Average values for the diagnosis "Methods of coping behavior"
(R. Lazarus test)

According to Figure 2, it can be noted that conscripts choose such coping strategies as: confrontation, distancing, escape-avoidance, positive overestimation very rarely (values less than 40), and coping strategies: self-control, seeking social support, taking responsibility and planning a solution to a problem - almost constantly (values between 40 and 60).

This means that enlisted personnel makes attempts to overcome negative experiences in relation to the problem by consciously suppressing and restraining emotions, reducing their influence on assessing the situation and choosing a strategy of behavior, high control of behavior, and striving for self-control. Also, servicemen solve problems by attracting external resources (social), seeking information, emotional support. They are characterized by an emphasis on interacting with others, expecting attention, advice and sympathy.

Enlisted personnel recognizes the problem and responsibility for solving it, overcome it by purposefully analyzing the situation and possible options for behavior, developing a strategy for solving the problem, planning their actions taking into account objective circumstances, past experience and available resources in some cases with a distinct element of self-criticism and self-accusation.

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According to Figure 3, it can be noted that among the conscripts on the scale, bargaining (2.6) and protest (3.2) are at a low level. This suggests that the military does not experience negative reactions in relation to the pandemic.

Such cales as denial (4.1), depression (4.2) and fear (4.2) are at the middle level. These results indicate that military personnel are slightly prone to depression and to a small extent there is fear and denial. This may be due to the fact that during the pandemic the servicemen were "cut off" from the outside world and were constantly in contact with the same people.

The scale has a high value - acceptance (5.5). This suggests that the servicemen have come to terms with this situation and are trying not to get depressed.

According to the hypothesis, it was highlighted that depending on the choice of coping strategies, the level of adaptation and behavioral response to the pandemic will change. A correlation matrix was built and the following correlations were obtained (while $p \leq 0.05$):

- a strong negative relationship between the component of adaptation "Behavioral regulation" and the following coping - strategies "Confrontation" ($r = -0.8$), "Distance" ($r = -0.81$) and self-control ($r = -0.76$), that is, these coping strategies carry a negative side and prevent servicemen from increasing their adaptive potential;

- a strong negative relationship between the adaptation component "Communication potential" and the following coping strategies "Confrontation" ($r = -0.7$), "Distance" ($r = -0.7$) and self-control ($r = -0.7$), that is, these coping strategies carry communicative threats that prevent a young fighter from creating a constructive communication situation;

- a strong negative relationship between the adaptation component "Personal adaptive potential" and the following coping strategies

"Confrontation" (r = -0.7), "Distance" (r = -0.7) and "Self-control" (r = -0.7), that is, these coping strategies negatively affect the potential of the individual and his internal resources;

- a strong negative relationship between "Maladaptive disorders" and the following coping strategies "Confrontation" (r = -0.8), "Distance" (r = -0.8) and self-control (r = -0.6), that is, data coping strategies affect the level of mental disorder of a soldier's personality.

If we state how much the level of adaptation affects the type of behavioral response to a pandemic, then only a tendency towards correlation was revealed here:

- a tendency towards a correlation between "Behavioral regulation" and the type of behavioral response to a pandemic "Denial" (r = -0.2): the higher the behavioral regulation, the lower the indicators of denial of the pandemic as such, and vice versa;

– also, the behavioral response to the pandemic "Denial" is inversely correlated with such adaptation components as "Communication potential" (r = -0.31) and "Asthenic reactions and states" (r = -0.3), that is, not knowing what a pandemic is leads to a denial of this global problem, and this reaction is formed among those respondents who do not deny the pandemic.

Discussion and Conclusions. Thus, the hypothesis of the study was partially proven, since not every variable of adaptability is interconnected with the coping strategies of enlisted personnel. There was also a tendency towards a correlation between adaptability and the type of behavioral response to a pandemic, in particular to the type of behavioral response "Denial".

It can be stated that the type of coping strategies is included in the system of the adaptive potential of the enlisted personnel. It was proved that the type of coping strategies is not always constructive in nature and forms not only the variability of the conscious actions of a young person, but to a greater extent bears an unconscious protective character.

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Аннотация. В статье представлены результаты эмпирического исследования взаимосвязи адаптационного потенциала военнослужащих срочной службы с копинг-стратегиями, а также типами поведенческих реакций на пандемию. Гипотеза исследования была частично доказано, так как не каждая переменная адаптивности взаимосвязана с копинг-стратегиями военнослужащих. Также была выявлена тенденция к корреляции между адаптивностью и типом поведенческой реакции на пандемию, в частности на тип поведенческой реакции «Отрицание».

Ключевые слова: военнослужащий срочной службы; адапация, нервно-психическая устойчивость, корреляция, личностный адаптационный потенциал, пандемия, тип реакции.

Annotation. The article presents the results of an empirical study of the relationship between the adaptive potential of enlisted personnel and coping strategies, as well as types of behavioral responses to a pandemic. The hypothesis of the study was partially proven, since not every variable of adaptability is correlated with coping strategies of enlisted personnel. There was also a tendency towards a correlation between adaptability and the type of behavioral response to a pandemic, in particular to the type of behavioral response "Denial".

Keywords: enlisted personnel, adaptation, neuropsychic stability, correlation, personal adaptive potential, pandemic, type of reaction

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FEATURES OF BEHAVIORAL RESPONSE TO PANDEMIC (ON THE EXAMPLE OF ENGLISH LANGUAGE TEACHERS)

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It is not the first time that modern society is faced with the conditions of a pandemic of a dangerous virus. However, in this case, unlike many previous ones, there are a number of distinctive features that make this pandemic unique. The most important fact in this case, from the point of view of psychology, is the presence of a rich theoretical and methodological base.

Modern psychological idea is affluent with theories and substantiations that allow a broader discussion of the phenomena under study. In addition, in modern times, giving strength and attention to psychological health is no less important than focusing on physical health. It is because of this fact the psychological aspect of experiencing a pandemic is a topic in demand and generates a significant amount of research.

Recent studies regarding the extreme situation associated with the COVID-19 pandemic have shown that the main anti-epidemic measures, such as social distancing and self-isolation, are stressful factors in their own right [2; 4], which, in turn, can complicate the adaptation processes, as well as increase the general level of anxiety in the population. A distinctive feature of the modern world and society is the accelerated development and transformation of the information environment that surrounds a person: the quantity and quality of information sources, methods of obtaining information, its inconsistency, heterogeneity, etc. [5; 6; 8].

According to a survey conducted in 2008, there were 34 million adults in Russia. (or 30%) of Internet users, and among Russians over 16 years old - 38 million people. (or 32%). According to the Ministry of Digital

Development, Communications and Mass Media of the Russian Federation, the monthly Internet audience of Russia in 2012 exceeded 55% of the country's population, 89% of Russian youth use the Internet constantly, and the spread of mobile Internet access in Russia in 2012 was over 55%. increased by 33% [3].

Thus, the information pressure that is now being exerted on people around the world in connection with the epidemic is extremely strong, and the psycho-traumatic nature of the content of information messages deserves an independent study. The information space is overflowing with conflicting information about the Coronavirus in various forms: reports, statistics, analytics, forecasts, comments, recommendations, public service announcements, and so on. Such a powerful and chaotic informational impact is certainly traumatic for the human psyche [7; 8; 9].

In conditions of social deprivation, memory impairment, perception, abstraction of thinking, concentration of attention, fluency of speaking are possible (for example, in hermits). Disorders of orientation in time, increased suggestibility, hallucinations and delusional states, excessive excitement, physical activity, irritability, fatigue, conflicts, psychosomatic symptoms, anxiety, fear, depression, suicidal tendencies, etc. [3].

Even after the weakening of quarantine measures, many people had all the symptoms described above, as already mentioned, readaptation will be purely individual. However, it should be noted that there is a group of people for whom this regime became favorable, they quickly adapted to it and minimized the influence of negative factors [**Ошибка! Источник ссылки не найден.**]. This was facilitated by: the presence of children, the safety of work, distance learning, the presence of hobbies, physical health, religious beliefs, selectivity in obtaining information from the media, hope for a favorable outcome of the resulting situation, remote support of social contacts, etc.

To study the types of behavioral responses to a pandemic using the example of English teachers, the following methods were used: diagnostics of socio-psychological adaptation (K. Rogers, R. Diamond) and the questionnaire "Behavioral responses to a pandemic" (T.D. Dubovitskaya, A.V. Shashkov).

The empirical study involved 36 English teachers. The age of the subjects varied from 24 to 56 years (the average age was 35 years), 31 women and 5 men.

The results, which were obtained by the investigated according to the main scales of the methodology of K. Rogers and R. Diamond for social and psychological adaptation, were converted into standard T-scores for

clarity of their comparison with the results of other methods. The distribution of the results of the subjects is shown in Table 1 and Figure 1.

Table 1. Results according to the method of socio-psychological stability determining by K. Rogers and R. Diamond

Parameter	Level		
	Low	Middle	High
Adaptation	13,89%	69,44%	16,67%
Self-acceptance	16,67%	63,89%	19,44%
Acceptance of others	19,44%	63,89%	16,67%
Emotional comfort	11,11%	69,44%	19,44%
Internality	16,67%	69,44%	13,89%
Striving for dominance	13,89%	72,22%	13,89%
Escapism	27,78%	50,00%	22,22%
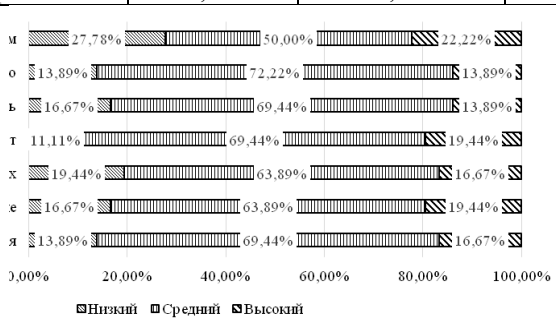
Picture 1 – The results of the method of the socio-psychological stability identification of K. Rogers and R. Diamond

For clarity of comparison, new data were converted into estimates in standard T-scores (a scale with a mean of 50 and a standard deviation of 10), where low scores are all scores up to 39, inclusive, high scores are from 61 points and above. in the interpretation of the methodology, mean values are indicated only for intermediate scales.

The most distinguishing are the following values: a small number of respondents who had low emotional comfort (4 respondents, 11.11%); a high number of subjects with low escapism (10 ones, 27.78%); a low number of respondents with high rates of striving for dominance and internality (5 subjects each, 13.89%).

This methodology "Behavioral responses to a pandemic" A.V. Dubovitskaya, A.V. Shashkov was used to determine the behavioral characteristics of experiencing isolation. The results obtained by the subjects were converted into standard T-scores for clarity of comparison.

The distribution of the results of the subjects is shown in Table 2 and Figure 2.

Table 2. The results of the respondents (Questionnaire "Behavioral responses to a pandemic" (T.D. Dubovitskaya, A.V. Shashkov)

Parameter	Level		
	Low	Middle	High
Adoption	13,89%	69,44%	16,67%
Depression	16,67%	63,89%	19,44%
Bargain	19,44%	63,89%	16,67%
Anger	11,11%	69,44%	19,44%
Negation	16,67%	69,44%	13,89%
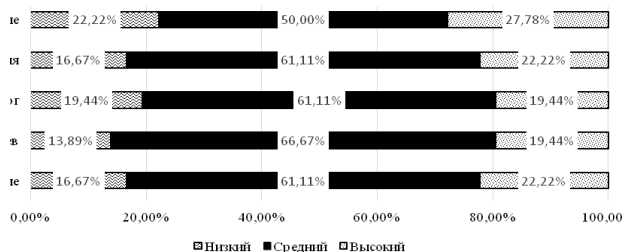
Figure 2 –The results of the respondents according to the questionnaire "Behavioral responses to a pandemic" (T.D. Dubovitskaya, A.V. Shashkov)

It should be noted that these results demonstrate the state of all indicators for each specific subject and it is they that are used in the process of mathematical analysis of data. However, the methodology also contains a variant of interpretation, which reflects not all points for each stage, but the leading stage, i.e. the one that the subject is more likely to experience at the time of testing. Data on the distribution of the leading stages in the subjects are shown in Table 3.

Table 3. The results of the respondents, the leading stage of the behavioral response to the pandemic

Leading stage of behavioral response	Number of subjects	Percentage of total number
Negation	5	13,89%
Anger	3	8,33%
Bargain	8	22,22%
Depression	9	25,00%
Adoption	9	25,00%

As you can see on the table, a significant part of the respondents (half of the entire sample) exhibit behavioral responses as leading, comparable to the two final stages of experiencing a traumatic event according to the results of the study.

Statistical processing of the research results was carried out in the Statistica 10 software package. To confirm or refute the formulated hypothesis, the nonparametric Spearman test was used to determine the correlations between the features. A similar decision was made based on the peculiarities of the formation of a methodology for determining the leading behavioral response in a pandemic. The difficulty is in the fact that the methodology has an extremely small number of values for each measured scale, which leads to significant deviations of the measured features from the normal distribution. A comparison of the real distribution of the trait and the normal distribution can be seen in the histogram illustrated in Figure 3.
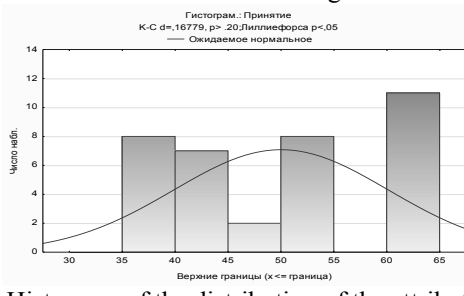
Figure 3 – Histogram of the distribution of the attribute "Acceptance".

On this histogram, the wavy line reflects the assumed normal distribution and, as you can see, the real distribution is completely different from the normal.

The results of statistical analysis using the Spearman's rank correlation coefficient are shown in Table 4. To obtain a more complete picture of the relationship of signs, the analysis included not only the main scales of the methodology for determining the socio-psychological stability of K. Rogers and R. Diamond, but also their subscales.

Consequently, of all the correlations determined as a result of the analysis, only the relationship between escapism and denial was determined with a significance level of ≤ 0.01, all other correlations were determined with a significance level ≤ 0,05.

Thus, summing up the results of the statistical analysis, we can assert the presence of the following relationships:

Direct link between the level of adaptability and the experience of depression as a behavioral stage in the response to a pandemic.

Table 4. Statistical analysis results (Spearman's rank correlation coefficient)

	Denial	Anger	Chaffer	Depression	Acceptance
Adaptability	-0,189	-0,124	0,325	**0,407**	0,062
Non-adaptability	0,282	0,137	0,323	0,170	-0,276
Adaptation	**-0,385**	-0,114	-0,013	0,196	**0,333**
Acceptance of yourself	-0,280	0,055	0,000	-0,136	0,182
Self-rejection	0,191	0,163	-0,088	-0,115	-0,038
Self-acceptance	-0,223	-0,024	0,040	-0,089	0,210
Acceptance of others	0,220	0,009	-0,143	-0,187	0,184
Not accepting others	0,134	-0,287	0,059	0,177	0,163
Emotional comfort	0,037	-0,006	-0,188	0,080	-0,099
Emotional discomfort	0,271	-0,030	-0,083	0,076	-0,011
Emotional comfort	-0,168	0,028	0,069	-0,062	-0,069
Internal control	-0,175	**-0,362**	-0,031	0,125	**0,402**
External control	-0,097	0,093	-0,136	0,192	-0,068
Internality	-0,071	**-0,380**	0,080	-0,029	0,290
Domination	-0,205	-0,114	-0,181	-0,088	0,121
Management	-0,133	-0,021	**-0,422**	-0,144	**0,356**
Striving for dominance	-0,011	-0,120	0,206	0,041	-0,232
Escapism	**0,425**	0,071	-0,177	-0,156	-0,052

Notes. Values in the table are highlighted in bold size that reflect reliable correlations between features. The critical values for the validity of correlations are as follows: 0,329 while ρ ≤ 0,05; 0,424 while ρ ≤ 0,01.

Consequently, the subjects with high adaptability also had high rates of depression. It should be noted that depression in this case means a stage that reflects an objective experience of grief about being in a crisis situation and this stage is the last one on the way to acceptance. Therefore, it can be assumed that the socio-psychological adaptability of the subjects contributes to the early passage of the previous stages of denial, anger and chaffer.

A direct link between adaptation and acceptance, and a feedback link between adaptation and denial. In this case, it can be assumed that a high level of socio-psychological adaptation contributes to the early transition to the stage of acceptance, especially the speed of transition concerns the first stage of experience - denial.

A direct link between internal control and acceptance, and a feedback loop between internal control and anger. This link of relationships can be viewed as the previous one. With a high probability, high indicators of internal control of the subjects contribute to the early onset of acceptance, especially in this case, the passage of the stage of anger will be quick.

Feedback between general internality and anger. The rapid passage of the anger stage is likely to be associated with the tendency of people with an internal locus of control to take responsibility for their failures and successes, while in the anger stage; responsibility for what is happening is mainly imposed on external objects.

Direct link between statement and acceptance, as well as feedback between statement and bargaining. In this case, one should take into account the fact that the statement as a whole can be viewed as a form of social behavior in which responsibility for complex decisions and choices is given to an external object - another person. Consequently, the quick passage of the bargaining stage and a high degree of acceptance in this case can be considered as a result of the manifestation of trust and submission to other people in the person of the media, the degree of interaction with which increases during isolation.

Direct link between escapism and denial. This connection is the most stable and strong in terms of the level of significance. Escapism is largely associated with avoiding difficulties and problems, while denial of an experience is nothing more than an attempt by the psyche to avoid all its consequences and the need to decide something and act in a certain way.

In general, it can be noted that the hypothesis formed at the beginning of the study is confirmed. The analysis revealed a number of relationships between behavioral responses to the pandemic and various parameters of socio-psychological resilience. A detailed explication of these relationships can be seen in table. 2.4. and further interpretation of its results. From all the signs of socio-psychological adaptation in a pandemic, when it comes to teachers of the English language, escapism should be considered the least suitable, which contributes to a long passage (or even looping) of the very first stage of denial. The most suitable in this case can be considered internal control, adaptation and statement.

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Аннотация. В статье рассмотрена проблема адаптации учителей английского языка к ситуации «пандемии», выявлены особенности механизмов адаптации и поведенческой реакции на ситуацию «пандемии» как стрессогенную для многих людей. Была доказана корреляционная прямая связь между уровнем адаптивности и переживанием депрессии как поведенческой стадии реакции на пандемию. Следовательно, у исследуемых с высокой адаптивностью были отмечены и высокие показатели депрессии. Следует понимать, что под депрессией в данном случае подразумевается стадия, отражающая объективное переживание горя относительно нахождения в кризисной ситуации и данная стадия является последней на пути к принятию. Следовательно, можно предполагать, что социально-психологическая адаптивность исследуемых способствует скорейшему прохождению предыдущих стадий отрицания, гнева и торга.

Ключевые слова: тип реакции на ситуации «пандемия», преподаватели английского языка, социально-психологическая адаптация.

Annotation. The article discusses the problem of adaptation of teachers of the English language to the "pandemic" situation, and identifies the features of the mechanisms of adaptation and behavioral response to the situation of a "pandemic" as stressful for many people. A direct correlation

has been proven between the level of adaptability and the experience of depression as a behavioral stage in the response to a pandemic. Consequently, the respondents with high adaptability also had high rates of depression. It should be understood that depression in this case means a stage that reflects an objective experience of grief about being in a crisis situation and this stage is the last one on the way to acceptance. Therefore, it can be assumed that the socio-psychological adaptability of the respondents contributes to the early passage of the previous stages of denial, anger and bargaining.

Keywords: type of response to the "pandemic" situation, English language teachers, social and psychological adaptation.

PECULIARITIES OF ATTITUDE TO MONEY IN HIGH SCHOOLS WITH DIFFERENT LOCUS OF CONTROL

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The theme of money psychology has been little developed in Russian psychology today and, although the prerequisites for the development of this direction can be found in the classical schools of psychology - psychoanalysis, behaviorism, humanistic psychology, cognitive theories, etc.

Freud's psychoanalytic theory of money considered the attraction to money as a consequence of subconscious accumulation processes associated with anal eroticism, and money itself was directly associated with the product of defecation [1]. In early childhood, when a child delays the departure of one's natural needs, he/she perceives their product as ones first wealth. [2]. This gives the young child a certain amount of power over their

parents, since the success or slowness of "saving" makes them happy or angry. Over time, these aspects of behavior turn into economic behavior when frugality (or, conversely, squandering) is a pleasure.

Within the framework of behaviorism, money was investigated as a means and a mechanism of conditional reinforcement. The similarity in the behavior of animals performing tasks for chips, which were then exchanged for food and a person working for money, manifested in experiments, gave possibility for B. Skinner to argue that money is only a generalized conditional reinforcement associated with a variety of goods and services that can serve as unconditional reinforcement [3].

In the context of humanistic psychology, the most significant problem of attitudes towards money was elucidated by A. Maslow, V. Frankl and E. Fromm. So, A. Maslow considered the desire for self-actualization as a desire to realize existential values which act as vital needs of the individual [3]. E. Fromm characterized the desire to have money as the opposite of the opportunity to become someone. As an axiom, he puts forward the thesis that monetarism, or the desire for money, is a closed worldview that does not allow and denies a holistic perception of life.

More particular mechanisms and patterns of reflection of money were investigated within the framework of the cognitive theory: attempts were made to highlight the mental mechanisms of monetary behavior, and an emphasis was made on the stages of development of the perception of money and attitudes towards them.

Modern research in Russia devoted to the psychological aspects of the attitude towards money is due to the socio-economic situation in the country and is represented by the following areas:

1) Socio-psychological changes in the economic consciousness and self-awareness of the individual and its components under the influence of a change in the forms and relations of property.

2) Dynamics of attitudes towards money among entrepreneurs.

3) Various aspects of a personal relationship to money.

Economic theories are based, as a rule, on the "facelessness", "identity" of money. In psychology, on the contrary, it is believed that money is always the object of value relations, and the valuation has a great influence on the functioning of specific monetary amounts depending on certain conditions. There are several general patterns of attitudes towards money identified in psychology:

– the perception of money is subjective and influences its use: large bills are usually associated with accumulation, small ones - with consumption;

– during the period of monetary reform, a different attitude towards old and new money is manifested: a person can lose in the calculation for the sake of possessing new money or make an irrational purchase in order to get rid of old ones;

– the attitude towards money is associated with the source of origin of a specific amount: with a careful and economical attitude towards wages, there is often a wasteful attitude towards unexpected income, especially if this money is undeserved;

– the attitude towards money depends on the specific purposes of their use; the so-called money laundering is based on this effect;

– different attitude towards some forms of money (cash, bills of exchange, bonds) and methods of cash and non-cash payments (checks, electronic cards);

– the use of money is governed by psychosocial norms and social values that change with the development of society.

Despite the much broader range of problems related to the attitude to money in foreign psychology, in comparison with domestic psychology, attention is drawn to the undeveloped aspect of the value-semantic relationship to money, depending on the individual psychological characteristics of different categories of the population. At the same time, as mentioned above, money in modern life is of such importance in all spheres that the peculiarities of the value-semantic attitude of a person to money has a significant impact on all spheres of his existence and development.

An empirical study of the attitude to money among senior pupils with different locus of control was carried out on the basis of the State Budgetary Educational Institution of Secondary School No. 9 of the city of Feodosia. The age of the subjects was from 15 to 16 years old. The sample consisted of 24 people. The following methods were used: Semenov M. Yu. Questionnaire "Assessment of monetary relations in schoolchildren" [5], J. Rotter, "Locus of control" methodology and "Methodology for the study of value orientations" by M. Rokich.

In the course of the empirical study, it became necessary to divide the group of subjects into two samples, characterizing the predominance of the internal and external locus of control. The analysis of the results showed that the external indicator locus of control was manifested in 62.5% (15 people) of the tested high school students, and the internal indicator locus of control was manifested in 37.5% (9 people) of the subjects [6].

The analysis of value orientations showed that in 100% (9 people) of the tested high school students with a previously identified indicator of internality, the presence of terminal (value-goals) values prevails. Subsequent work with the methodology showed that in 86.7% (13 people)

of the tested high school students with the previously identified indicator of externality, the presence of instrumental values prevails. The high school test subjects are more focused on health, love, family and friends. It is not so important to focus on the beauty of nature and art, creativity and the happiness of others.

Then the questionnaire "Assessment of monetary relations among schoolchildren" was conducted with the high school students, the author of which is M. Yu. Semenov. In 42% of high school students with an external indicator, the locus of control revealed the following features: they have an adequate and rational attitude to money; usually keep personal financial records; lend easily; having money makes them feel better; and most likely they often discuss money problems with others. Among the tested high school students with an internal indicator, the locus of control has such characteristics only 11 %.

Low scores on the "art of managing money" scale among 34% of senior pupils with an internal indicator locus of control can be interpreted as inability to manage money, a disdainful and irrational attitude towards it; they don't see much sense in money; they are not very interested in topics related to money.

The high values of 40% of senior pupils with the external indicator locus of control on the scale "the motive to save" explain the fact that they value money highly, sometimes even overestimating its importance; try to save money, not waste money. At the same time, 32% of the tested high school students with the internal indicator locus of control who received low values on this scale often underestimate the importance of money and do not try to save money; they can use money and things to demonstrate their attitude towards people; but they often make gifts.

High anxiety about money was found in 52% of senior pupils with an external locus of control indicator, and only 21% of tested senior students with an internal locus of control indicator. It remains to add that money often occupies their thoughts and attention, is for them an emotionally saturated object.

The largest percentage of high school students (57%) with an external index of locus of control have high values on the scale of "stress over money". That means that they generally have a negative attitude towards money: money is evil; at the same time, people are compared in terms of money and wealth; they are characterized by contempt for money and a hidden desire to get rid of it. At the same time, every third high school student with an internal indicator locus of control (31%) showed low indicators on this scale. This can be explained by the fact that they have

neutral or positive emotions associated with money; there is no feeling of guilt about money; This group of students uses money quite rationally.

Thus, this empirical study shows how relevant is the study of the characteristics of young men 's attitude to money, in general, the study of monetary behavior. One psychological condition that can affect attitudes towards money is the locus of control. In this robot, we tried to highlight only some of the features of high school students with external and internal locus control. In the future, it is necessary to study a large sample of subjects in order to highlight significant relationships between the psychological properties of the personality and the attitude towards money.

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Annotation. В данной статье рассматривается теоретический анализ проблемы монетарного поведения у старшеклассников, а также представлено эмпирическое исследование, которое показывает, насколько актуально изучение особенностей отношения к деньгам у юношей, в целом изучения монетарного поведения. Одним психологическим условием, которое может повлиять на отношение к деньгам – это локус контроля.

Keyword: монетарное поведение, отношение к деньгам, локус контроля, юношеский возраст.

Annotation. This article examines a theoretical analysis of the problem of monetary behavior in high school students, and also presents an

empirical study that shows how relevant is the research of attitudes characteristics towards money in young men, in general, the study of monetary behavior. One psychological condition that can affect attitudes towards money is the locus of control.

UDC 378

SCIENTIFIC ACTIVITY AS A WAY OF FORMING THE PROFESSIONAL COMPETENCE OF A TEACHER

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Problem statement. Psychological and pedagogical training of a teacher assumes knowledge of the methodological foundations and categories of pedagogy; laws of socialization and personality development; essence, goals and technologies of education and training; laws of age anatomical, physiological and mental development of children, adolescents, youth. However, psychological, pedagogical and special knowledge is not enough to master professional competence. There is a need for the ability to think and act pedagogically, and this is facilitated by the teacher's participation in scientific activities. Due to the scientific research carried out by the teacher, the ability to move from the concrete to the abstract will develop at the intuitive, empirical and theoretical levels.

Analysis of research and publications. The works of O.A. Abdullina, A. V. Gluzma, Ye.A. Klimov, A.K. Markova, N.E. Onischenko and others were dedicated to the research of the scientific activity as an area of the development of professional competencies of a teacher. Theoretical and methodological foundations of the process of pedagogical preparation of the future teacher were studied by I.P. Podlasy, V.A. Slastenin, N.E. Stenyakov and others. The main provisions of education, training and upbringing are reflected in the works of M.E. Vayndorf-Sysoeva, S.U. Goncharenko, L.V. Bayborodova, L.P. Krivshenko, N.B. Protasov, M.I. Rozhkov.

The purpose of this article is to highlight scientific activity as a way to form the professional competence of a teacher.

In the process of forming the professional competence of a future teacher, research work takes a leading place and performs a number of tasks, such as:

• the formation of a scientific outlook, mastery of the methodology and methods of scientific research;

• expansion of the theoretical horizons and scientific erudition of the future specialist;

• instilling in future teachers skills of independent research work, involving them in solving scientific problems;

• deepening of knowledge in a certain scientific direction, the formation of skills in the preparation of scientific publications;

• creation of scientific schools among senior pupils, creative teams in their further pedagogical activity, involving different age groups of children in cooperation;

• development of creative thinking and individual abilities of students in solving pedagogical theoretical and practical problems.

Research work of students, future teachers, should be directed to the development of a system of intellectual creative qualities of a person such as: intuition (direct vision of the essence of things); creative thinking (the ability to produce new ideas, hypotheses, ways of solving problems); creative imagination (independent creation of new images that are realized in the original results of activity); divergence of thinking (the ability to offer several approaches to solving a problem and change them, see problems, objects from different aspects); originality of thinking (originality of the qualities of the mind, the image of mental activity); associativity of thinking (the ability to use associations, including analogies) [3].

A student who is engaged in scientific work is responsible only for oneself: the topic of research and the timing of the work depend only on his choice. Research activity develops professional competence, important for the future teacher, which consists of the following components: creative thinking, responsibility, the ability to defend one's own point of view [2]. With the correct organization of scientific activity, the future teacher develops professional skills to the theoretical level of analysis. The result is the integration of pedagogical skills to think and act. V.A. Slastenin notes that, regardless of the level of generalization of the pedagogical task, the completed cycle of its solution leads to the triad of "to think - to act - to think" and distinguishes the following groups of pedagogical skills [3, p. 42]:

1. The ability to transform the content of the objective process of education into specific pedagogical tasks: the study of the individual and the team to determine their readiness to actively master new knowledge and design on this basis the vector of development of the team and individual students.

2. Ability to comprehensively plan teaching and educational tasks; justify the choice of the content of the educational process; optimal selection of forms, methods and means of its organization.

3. Ability to identify and establish relationships between the components and factors of education, activating their activities. The teacher must learn to create the necessary conditions for their implementation; activate the student's personality, contribute to the development of his activities, turning him from an object into a subject of education; analyze and regulate external non-programmable factors of influence on the student.

4. Ability to conduct self-analysis of one's own pedagogical activity and determine the following complex of pedagogical tasks: primary and secondary.

The level of development of a teacher's scientific activity is determined by the formation of analytical skills. It is an analytical skill that implements the generalized ability to think in a pedagogical way. The theoretical analysis of facts and phenomena involves the assessment of educational material in a comprehensive manner based on didactic principles [1].

Knowledge of the scientific foundations provides the future teacher with the ability of pedagogical forecasting, which, in turn, relies on knowledge of the essence and logic of the pedagogical process, the laws of the age and individual development of students. Pedagogical forecasting requires the teacher to master the following scientific methods such as modeling, extrapolation, and the like. Mastering a teacher of narrowly focused scientific methodological skills allows you to develop projective skills, which are reflected in the materialization of the results of pedagogical forecasting in specific plans of training and education [3, p. 45].

Scientific analysis of one's own actions, deeds, thoughts develops reflexive skills (the teacher carries out control and evaluative activities of his own work), which recognize reflection as a specific form of theoretical activity. The scientific activity of the teacher, of course, influences the formation of the scientific worldview of students. The transformation of knowledge into worldview attitudes and beliefs is associated with the formation of a system of attitudes among students to the world and to oneself, which is formed in the process of the individual's activity. The level of formation of the scientific worldview is evidenced by the answers of students from worldview questions in the classroom, their activities and behavior in various situations, comparative observations of teachers.

Since the worldview is a system of scientific, political, philosophical, legal, aesthetic, moral concepts, views and beliefs that determine a person's attitude to the world around him and to himself, then each academic subject is an integral part of a single whole in its formation. A teacher can successfully form the scientific outlook of students only if he knows well not only his subject, but also related disciplines and implements

interdisciplinary connections in the learning process. This allows to reveal the scientific picture of the world.

Conclusions and research results, prospects for further research in the proposed direction. Each teacher in the process of his activities develops professional and pedagogical knowledge and accumulates work experience, which must be transformed into a generalized ability to think pedagogically, and this, in turn, implies the development of analytical, prognostic, projective, and reflexive skills in the teacher.

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Аннотация. В статье рассматриваются вопросы научной деятельностью как основы формирования профессиональной компетентности будущего учителя. Выделены задачи для формирования научного мировоззрения и базовые составляющие научно-исследовательской деятельности, которые развивают профессиональную компетентность будущего учителя.

Ключевые слова: компетентность, профессиональная компетентность, научно-исследовательская деятельность, научное мировоззрение.

Annotation. The article deals with the issues of scientific activity as the basis for the formation of the professional competence of a future teacher. The tasks for the formation of a scientific worldview and the basic components of research activities that develop the professional competence of the future teacher are highlighted.

Key words: competence, professional competence, research activity, scientific outlook.

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OPPORTUNITIES OF THE DISCUSSION PLATFORM IN FOREIGN LANGUAGE SKILLS FORMATION

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The development of science and innovative technologies provided new interdisciplinary fields, which led to the emergence of terms that reflect the professional - linguistic consciousness, but also complicate communication.

Today, a foreign language plays an essential role in the multicultural linguistic person formation, who is ready for professional communication with representatives of other cultures, possessing the skills to overcome language barriers and ready for creative self-development and realizing ethnocultural and self-determination. The purpose of foreign language teaching is both the development of communicative skills of speech activity, and the personality formation with the ability to understand the similarities and differences of the conceptual system of representatives of different linguistic cultures and, in accordance with this, carry out intercultural interaction in a foreign language based on linguistic competence [1].

The studies of the educational process organization in the field of teaching foreign languages were considered by M.Yu. Krapivina, G.V. Rogova, P.V. Sysoev, S.G. Ter-Minasova et al. Linguistic competence development by means of a professional situation as a model for organizing the educational activities of students in the context of foreign language learning was described by O.G. Artemova, N.A. Maltseva, E.G. Galizin et al. The Discussion Board in learning was considered by Michael R. Bleich, J Contin Educ Nurs, Hew, Khe Foon, Cheung, Wing Sum et al. Heather Honoré Goltz and Matthew Lee Smith studied forming and developing professional identity.

The purpose of this article is to explain the concept of a discussion platform in the formation of foreign language communication skills.

"One of the hardest things for a teacher is to build a classroom community where relevant conversations happen and all students are engaged in thought-provoking topics" [23, www]. Using different discussion tools can be a way to help future specialists build conversation skills and increase their engagement. With discussions, they have the opportunity to interact with each other and share their opinions.

A means of ensuring the successful introduction of students into a situation of a dialogue of cultures, as well as the development of

sociocultural aspect, can be a discussion platform within the framework of the work of sections on the problems of organizing innovation in the relevant subject areas. Subsequently, such situations are transferred to the real conditions of intercultural communication, which significantly affects the quality of communication, can avoid communication failures and overcoming socio-cultural stereotypes.

Interaction between students of different areas of professional training in order to exchange new knowledge, develop and realize creative potential in scientific and innovative activities is provided by a scientific and practical conference in foreign languages, within which discussion platforms are created [2-20, 22, 24-41].

A discussion platform is an area for live communication and discussion of the most important issues, where in a friendly atmosphere we can talk about experiences, share techniques and "life hacks", learn more about each other and about innovations. The discussion board is an essential tool to advance leadership development. Both learner and educator topics are provided for discussion board optimization.

Basic requirements for creating a discussion platform are the following:

– the platform should unite students of different directions, with different levels of training;

– the platform is an open system related to the external environment;

– modeling of professional communication should take into account the ethno-cultural specifics of interaction, socially fixed norms, respect, tolerance.

Discussion platforms are viewed as the heart of conferences, and for good reason: the students can interact with one another, sharing, debating, and offering ideas, suggestions, insights, and information that can stimulate the learning process [21].

Opportunities for a discussion platform are: testing ideas and identifying shortcomings, ways of their development (SWOT analysis), which can become the basis for the development of new strategies; finding new approaches to solving challenges in modern society, realization of scientific projects in our conference "Recent Achievements and Prospects of Innovations and Technologies".

Completed projects within the framework of discussion platforms were:

"*The Ice Regime of the Sea of Azov in the Conditions of Modern Climate Change*" [2, p. 498-502];

"*Smoking Cabs as a Way to Clean Air*" [3, p. 124-125];

"*Cooling System for Smartphones from FUJITSU*" [4, p. 75-78];

"*Human Brain Project*" [5, p.286-289];

"*Attitude to Physics Practicum According to the Results of a Survey of 1-4 Years Physics Students*" [6, p. 614-617];

"*Electronic Medical Records*" [7, p. 144-148];

"*Mobile Trends in 2019*" [8, p. 239-241];

"*Innovate Tools and Techniques for Process Improvement in IT Management*" [9, p. 64-68];

"*Virtual Reality Technology and its Prospects*" [10, p. 205-209];

"*Design Impact on Business Success*" [11, p. 191-197];

"*Research of Consumer Usage and Perception of Voice Assistants*" [12, p. 183-186];

"*Smart house system*" [13, p. 185-188];

"*Bandgap Voltage Reference in CMOS Technology*" [14, p. 19-21];

"*The International Project "Nica Complex"*" [15, p. 176-180];

"*How Much is Advertising in the Instagram?*" [16, p. 249-252];

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"*The latest Cosmological Achievements*" [18, p.186-189];

"*Influence of Bacteria on the Microbiome of Organism'* [19, p. 296-300];

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"*Web-Designer vs Web-Developer*" [24, p. 244-248];

"*Money in Present Times*" [25, p. 140-143];

"*Digital Devices in System of Education*" [26, p. 277-279];

"*Flettner Rotor and Turbosail from Cousteau*" [27, p.418-422];

"*New Approaches to Direct Digital Synthesis*" [28, p. 54-59];

"*Analysis of Modern Tools for a Mobile Apps Development Running on Android and IOS*" [29, p. 269-273];

"*Retoucher – Profession of the Future*" [30, p. 283-287];

"*Are Robots Replacing Jobs?*" [31, p. 251-258];

"*The principles of the selection of perimeter protection detectors*" [32, p. 21-26];

"*Measuring Transducer Based on a Waveguide Tee-Band*" [33, p. 305-310];

"*What is Military Interpreting?*" [34, p. 365-369];

"*Could Google Change the Future of Gaming?*" [35, p. 248-250];

"*Understanding of Beauty since Ancient Time to the Present Days: Sport Nutrition and Health*" [36, p.205-206];

"*Analysis of the Relationship Between Private and Public Law in Crimea*" [37, p. 540-543];

"*Nanostructures Promise Iceproof Surfaces: Superhydrophobic Ones*" [38, p. 517-520].

Conclusion. In order to develop the high professional mobility, professional situations are created within the framework of discussion platforms. Such an effective way of organizing the educational and scientific activities of students in foreign language communication will serve as a template for dialogues within the framework of professional interaction in future. Discussion platforms can engage students in collective reflection and exchanging perspectives and cross-cultural understanding. It provides the real conditions of intercultural communication, which significantly affects the quality of communication.

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Annotation. The report presents the possibilities of a discussion platform in the formation foreign language communication skills. The effective ways of organizing educational and scientific activities of students

in the context of foreign language professional communication learning are considered.

Keywords: foreign language, discussion platform, situations of professional communication, intercultural communication.

Аннотация. В докладе представлены возможности дискуссионной площадки в формировании навыков иноязычного общения. Рассмотрены эффективные способы организации учебной и научной деятельности студентов в контексте обучения иноязычному профессиональному общению.

Ключевые слова: иностранный язык, дискуссионная площадка, ситуации профессионального общения межкультурное общение.

STRATEGIES FOR MUTUAL ADAPTATION

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Introduction. The problem of mutual adaptation presents a particular interest as "adaptive performance", which reflects the ability of an employee to work as efficiently as possible even under unusual circumstances as setting new tasks. For example, a low level of mutual adaptation can lead to the failure of the goals and objectives proposed by the specialist. Adaptive productivity, according to experts, is an important aspect of efficiency and productivity [1].

The problem of adaptation is relevant for all levels of education [5]. Despite the existing differences in the target, content and procedural components, at each educational level, the adaptation process is characterized by the presence of both specific and general [8]. The success of adaptation largely depends on how adequately a person perceives his/her social position, qualities and social connections [1].

The need for person's adaptation originates when he/she begins to interact with any system under conditions of a certain disagreement, which provides the necessity of changes. These changes can be associated with the person himself or the system with which he interacts, as well as the nature of the interaction between them. That is, the starting mechanism of the human adaptation process is a change in his environment, in which his usual

behavior turns out to be ineffective or generally ineffective, which gives rise to the need to overcome difficulties associated precisely with the novelty of conditions.

Scientists consider adaptation as a process and result of establishing a harmonious relationship between the individual and the social environment (Reiser B.J., Spillane J.P., and Steinmuller F., Sorsa D., Carney K., and Kyza E., Bennett M., Castiglioni I., Leslie Santee Siskin и др). They understand adaptation as the process of interaction between a person and the environment, as a result of which models and strategies of behavior emerge which are adequate to the conditions changing in this environment and they consider it possible to apply this general definition to the conditions of the educational environment.

The purpose of this article is to analyze strategies for mutual adaptation, to determine their effectiveness.

Research methods. There are studies showing that the greatest adaptive effect, reflecting a high level of adaptation, provided by a combination of strategies aimed at actively and simultaneously changing oneself and the environment. The external adaptation to the educational environment of a person can result to the moderate adaptation result, which does not cause intrapersonal changes, as well as two alternative models of behavior: leaving the environment or waiting for external and intrapersonal changes. A low level of adaptation, associated with a pronounced negative effect in adaptation, is manifested in the person's refusal to interact with the external environment and in immersion in his/her inner world.

The main material. Some scholars associate the adaptation process with inclusion in a new linguistic environment and culture. "Adaptation is the application of Acceptance, and it is likely to become the predominant experience when there is a need to actually interact effectively with people of another culture" [8, p. 245].

Reiser B.J., Spillane J.P., & Steinmuller F., Sorsa D., Carney K., and Kyza E. Noted the special role of a tutor in the adaptation process. "Teachers' task concerns had to do chiefly with the ambitious and open-ended nature of the task and whether students would have the necessary background conceptual knowledge and skills" [11].

We agree with Leslie Santee Siskin that adaptation is a process of collaboration and a way of thinking—shared with your partner of communication. It is a mutual adaptation that has its own benefits in increasing ownership and commitment as "a powerful experience" [9].

Mutual adaptation in action is an organizational learning which takes [9] place on both sides, and the designers themselves incorporate what they learn from local adaptations into the next iteration of their design,

potentially strengthening not «only the design, but also their capacity to go to scale" [9, p. www].

In this study, we understand mutual adaptation as a process and result of the mutual activity of the individual and the group, associated with the individual's assimilation of the goals and objectives, norms and values of the group, determining the place in the system of relations in accordance with mutual interests and capabilities.

While starting communication, it is necessary to evaluate the communication partner as a person, to correlate your interests with one's interests, to choose the most suitable communication technique and methods, which is the second stage of the process of forming readiness to overcome emotional barriers of communication - individualization. Intrinsic motivation training is used for this purpose [5]. Before defining strategies for mutual adaptation, it is useful to determine its type:

– intercultural adaptation – acculturation, entry into a new cultural environment;

– psycho-physiological adaptation – getting used to a new environment, a regime that is determined by the state of health;

– –socio-psychological - adaptation in the team, knowledge of the values of the company. At this stage, the person faces serious problems (for example, he/she expected quick success, but expectations were not met; he/she overestimated the importance of theory and instructions, and, on the contrary, did not attach importance to the importance of practical skills and live communication, etc.);

– socio-organizational – getting used to the new environment, in particular to administrative, legal, socio-economic and managerial aspects.

– professional - mastering technological processes and standards.

In the case of blended learning as a new learning environment, mutual adaptation refers to the socio-psychological and socio-organizational types, which are characterized by the unity of adaptive and transformative activities. For a person, mutual adaptation acts as a search activity flexibly organized under new conditions, an individual's exit beyond the bounds of the finished final form. And the less the personality principle is expressed in the individual, the more mutual adaptation has the character of adaptation to the conditions of the social environment.

The relationship between the individual and the group will be effective, i.e. the result is an adaptive performance, when a person productively performs the leading activity without prolonged internal and external conflicts, satisfies one's basic social needs, meets those role expectations that the reference group presents to him/her, experiences states

of self-affirmation and free expression of one's creative abilities, resolution strategies [4].

It will be appropriate to apply strategies of internal conflicts here. The process of mutual adaptation is meaningfully an active formation of strategies for coping with a stressful situation through mechanisms of different levels of regulation. Motivational-volitional strategies act as a system-forming factor of adaptation that determines the intensity and direction of activation-energy, cognitive and emotional-evaluative processes that ensure the activity of the individual [2]. Intrapersonal adaptation is primarily associated with the subject's ability to resolve their intrapsychological conflicts in the form of coping behavior. An internal conflict is created between various motivational formations in the conscious-unconscious sphere of the individual [3]. A person's own emotional experience perceived by a person is subjectively interpreted as a psychological problem that is significant for a person, requiring its resolution and causing internal work aimed at overcoming it [3]. "Self-determined motivation results from the interaction between people's inherent active nature and the social environments" [10, p. 124].

Intrapersonal adaptation is primarily associated with the person's ability to resolve one's psychological conflicts in the form of coping behavior. An internal conflict appears between various motivational formations in the conscious-unconscious sphere of the individual. A person's emotional experience perceived by a person is subjectively interpreted as a psychological problem that is significant, requiring its resolution and causing internal work aimed at overcoming it [1].

Conclusion. Thus, one of the most important social factors influencing the student's behavior, one's relationship with others and university teachers is the change in the social situation, the need to get used to new learning conditions, the development of a new social role in blended learning.

For productive interaction and the choice of the correct relations trajectory, social knowledge is required, including the assessment of interpersonal relationships, strategic planning of communication, assimilation of the experience of social interaction, and social intuition. The experience of social interaction is integrated into the process of university education in the basics of intercultural communication [7-9]. Communication is built on the condition of observing the principle of socio-cultural adequacy, which becomes a universal means of cognizing culture.

The relationship between the individual and the group will be effective when the individual, without long-term internal and external conflicts, productively performs one's leading activity, which is facilitated by the strategies of internal conflicts.

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Аннотация. Рассмотрена одна из важнейших педагогических задач вуза – создание условий, способствующих более быстрой и успешной адаптации студентов к новой смешанной системе обучения. Низкий уровень взаимной адаптации может приводить к срыву поставленных целей и задач. Адаптивная производительность является важным аспектом эффективности профессиональной деятельности в целом.

Ключевые слова: адаптация, смешанное обучение, психофизиологическая адаптация, межкультурная адаптация, социально-психологическая адаптация.

Annotation. One of the most important pedagogical tasks of the university is considered, namely the creation of conditions providing more successful adaptation of students to the new mixed learning system. A low level of mutual adaptation can lead to the failure of the set goals and objectives. Adaptive performance is an important aspect of overall professional performance.

Keywords: adaptation, blended learning, psycho-physiological adaptation, intercultural adaptation, socio-psychological adaptation.

YURI BORISOVICHGIMPILEVICH- SCIENTIST, TEACHER, DIRECTOR
(To 70th anniversary)

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Introduction

The milestones of the creative and life path of the director of Radio Electronics Institute and Information Security of Sevastopol State

University, Doctor of Technical Sciences, Professor Yuri Borisovich Gimpilevich are reflected in the works [1-5], most fully-in the publication [6], which covers the period up to 2015. This paper focuses on the period 2015-2020.

1950-1974.

Yuri Borisovich was born on April 16, 1950 in the Voroshilovgrad (Luhansk) region. Until 1961, he lived with his parents in the city of Isfara, Lenin-Bad region (Tajikistan). In 1961, the whole family moved permanently to the Crimea, where Yuri Borisovich graduated from secondary school No. 10. Yalta with a silver medal. In 1967, he entered the Sevastopol Instrument-Making Institute (SPI), from which he graduated with honors in 1972. On distribution, he was sent to the design bureau of the radio engineering plant of Shipbuilding Industry Ministry in Moscow. Serpukhov, Moscow region, where he worked as an engineer until November 1974. Productive industrial activity, thanks to the irrepressible energy of Yuri Borisovich, was combined with social work. So from 1972 to 1974. He was the deputy chairman of the Serpukhov City Council of Young Scientists, a member of the commission linked with the development of scientific and technical creativity of young people (NTTM) Moscow Regional Committee of the Komsomol, a member of the Komsomol committee bureau of the radio factory, chairman of young specialists council of the radio factory.

1974-2006

In the period from 1977 to 1979. Yuri Borisovich worked as a senior researcher at the Theoretical Foundations Department of Radio Engineering of the SPI, in 1979 he was elected an assistant, in 1980 — an associate professor of the department. Yu.B. Gimpilevich has always successfully combined his fruitful academic work with research activities. The main directions that defined the circle of scientific interests of our hero were: control and diagnostics of parameters of radio engineering systems, microwave measurements, development of methods for analyzing signals and circuits.

Intensive scientific work (only for the period from 1985 to 2003 Yuri was in charge of five contractual research and scientific supervisor of three research related to the development and study of measuring means of the microwave range) resulted in a successful defense in 2005, doctoral thesis, Kharkiv National University of radio electronics, specialty "Radio engineering and television systems". Since September 1, 2004, Yuri Borisovich was elected Head of Radio Engineering Department and Telecommunications of SevNTU, on April 20, 2006 he was awarded the academic title of Professor.

2006-2015

During this period, Yu.B. Gimpilevich was a member of the specialized Scientific Council D 64.052.03 at the Kharkiv National University of Radioelectronics, a member of the editorial boards of scientific collections: "Scientific Works of the Naval Academy named P.S.Nakhimov", "Bulletin of Sev-NTU. Series Informatics, Electronics, Communications", "Radio Engineering", "Microwave Equipment and devices", head and member of a number of international scientific organizational and program committees and technical conferences, including "Microwave equipment and Telecommunications technologies" (since 1991), "Modern problems of radio Engineering and telecommunications", etc. The Department of Radio Engineering and Telecommunications collaborated with the state enterprise Research Center "Omega", which specializes in conducting functional tests, tests for electromagnetic compatibility, electrical safety, and environmental resistance, which makes it possible to perform certification of telecommunications equipment, radio-electronic and household appliances. The company employs many graduates of the department, including the director of the center Belikov N.I. In the course of long-term scientific and technical cooperation of the RE Department with the S.A. Lavochkin NPO (Moscow), a group of department employees developed a system for monitoring the parameters of onboard microwave paths of Venus-type spacecraft. It should be noted that the importance and capabilities of this scientific direction not only do not weaken over time, but also become increasingly relevant, since they are quite successfully used in scientific research, sometimes very far from radio engineering, dramatically increasing their effectiveness and reliability. During these years, RE Department actively cooperates with the design bureau of the industrial group "Tavrida Electric", which is one of the world leaders in the production of switching equipment. Therefore, the research, improvement and testing of vacuum switching equipment is an important scientific and technical task. In the framework of this direction under the leadership of Yu.B. Gimpilevich containing HN, several research works, which resulted in the development of a number of methods of testing of vacuum circuit breakers, computer models of the switch in different modes of short-circuit three-phase network, the principle of building a microwave noncontact measuring the parameters of movement of parts of switching devices, as well as the monitoring system of thermal processes powerful electrical equipment. During these years, Yuri Borisovich pays great attention to the development of international cooperation. Close scientific and industrial contacts have been established with the company "MELEXIS" (Belgium):

A training and research laboratory for the development of integrated circuits, including radio frequency range, was established, the department's employees were trained in the company's divisions in Erfurt (Germany) and participated in the implementation of joint projects.The department cooperates with the company LEDS (Toronto, Canada). The main direction of the company's work is RFID radio frequency identification systems. These systems are a very promising direction, based on advances in digital processing of radio signals, microelectronics and microtechnologies: almost any object (from a label on a product to a huge ocean container ship) is embedded with a superminiature chip, which allows you to get complete information about the object. The creative team of the department's employees carried out a pilot project in the company LEDS. The staff of the department performs a number of topics for the company "WAVES AUDIO Ltd." (Tel Aviv, Israel), starting with the development of a specialized digital signal processor. Cooperation is developing with the MARMARA Scientific and Technical Center (Turkey) on the development of a microwave tomograph for the search system for people under the rubble, and with the ASTRON research center (Holland) as part of an international project to modernize large radio telescopes.

2015-2020

In 2015, Yu. B. Gimpilevich was appointed Director of the Institute of Radio Electronics and Information Security (IREIS) Sevastopol State University (SevSU), reorganized in 2014 on the basis of the Sevastopol National Technical University. In 2016-2017 was the acting Vice-rector for research and innovation Sevgi. The IREIS consists of four departments: "Radio Electronics and Tele-communications", "Information Security", "Electronic Engineering" and "Physics". In 2018 On the basis of the Department of Radio Electronics and Telecommunications, the basic department of Innovative Radio Electronics was organized, which also became part of the Institute.

92 teachers Institute (10 professors, 51 assistant Professor, 18 professors, 13 teachers and assistants) are bachelors, masters and specialists in the following areas:

— 03.03.02 "Physics" (the bachelor and the magistrate-RA);

— 10.03.01 "Information security" (bachelor and master);

— 10.05.01 "Computer security" (SPE-ciality);

— 11.03.01 "Radio engineering" (bachelor and master);

— 11.03.02 "Infocommunication Technologies and communication systems" (bachelor's and Master's degree);

– 11.03.03 "Design and technology of electronic means" (bachelor's degree);

– 11.03.04 "Electronics and Nanoelectronics" (bachelor's and Master's degree);

– 11.05.01 "Radio-electronic systems and Complexes" (specialty).

Scientific achievements, social activities, awards:

Yu.B. Gimpilevich is the author and co-author of more than 250 scientific papers, 22 copyright certificates, one patent of the Russian Federation and six patents of Ukraine, three monographs and a textbook with the stamp of the Ministry of Education and Science of Ukraine.

Yuri Borisovich is constantly engaged in the training of scientific personnel, supervising doctoral and postgraduate studies in two scientific areas. He prepared Doctor of Technical Sciences Shirokov I.B. and candidates of technical Sciences Smailov Yu.Ya., Vertegel V.V., Savochkin D.A. The work of Zebek S. E. is presented for defense.

In 2008, by the decision of the Rector's office of SevNTU, the portrait of Yuri Borisovich Gimpilevich was placed on the Board of Honor of Sevastopol for his outstanding achievements in his work.

In 2019, Yu. B. Gimpilevich was elected Chairman of the Professorial Assembly of Sevastopol.

Conclusion

The fruitful activity of the scientist and organizer of science Yuri Borisovich Gimpilevich deserves a more detailed study.

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Аннотация. Рассмотрен творческий и жизненный путь директора Института радиоэлектроники и информационной безопасности Севастопольского государственного университета, доктора технических наук, профессора Юрия Борисовича Гимпилевича.

Ключевые слова: Севастопольский государственный университет, Юрий Борисович Гимпилевич, радиотехнический факультет.

Annotation. The creative and life path of the Director of the Radio Electronics Institute and Information Security of Sevastopol State University, Doctor of Technical Sciences, Professor Yuri Borisovich Gimpilevich is considered.

Keywords: Sevastopol State University, Yuri Borisovich Gimpilevich, Department of Radio Engineering.

THE SENSE OF HUMOR FEATURES OF DIFFERENT DEPRESSION LEVELS IN YOUTH

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Introduction. The psychology of humor was studied in the context of clinical practice. Scientists have studied the spontaneous manifestation of laughter, smile, verbal and behavioral sense of humor (foolishness, gaiety). Humor is an individual personality-psychological feature that manifests itself in the ability to notice the contradictions and features of the surrounding world, people and events from a comic point of view [1, 2].

On the other hand, depression, is a mental disorder that includes a decrease in mood, disturbances in thinking (a pessimistic view of everything that is happening around, a loss of the ability to feel joy, negative judgments), and motor retardation.

The purpose of the article is an empirical study of the specifics of the sense of humor with different levels of depression in the period of early adolescence.

Research hypothesis: It is assumed that there is a relationship between the level of depression and sense of humor during early adolescence.

Research methods: "Depression Inventory" method by Beck; Methodology "How to Measure Personality. Sense of humor" by G. Eysenck and G. Wilson; Spearman's rank correlation method.

The study was carried out on the basis of the Municipal Budgetary Educational Institution "Secondary School No. 15" in Feodosia during the 2020-2021 academic year.

The study involved 25 students in grades 10-11.

10 (45%) are girls and 15 (55%) are boys aged 16 to 18 years.

According to the results of "Beck Depression Scale" methodology, one can see the general dynamics of the types of depression in adolescents: the majority of the subjects (60%) did not have depression, which means that this group of respondents has the most harmonious relationships with themselves and the world around them. Understanding their own emotional states was not a problem for them.

There were also respondents (28%) who were stated to be called as "light" zone - they did not belong to people with depression, but they had problems with mood restructuring, loss of interest in activities that carried them away before or loss of pleasure from these activities; change in appetite - weight loss or gain not related to diet; insomnia or too long sleep. All this created an atmosphere of inner tension, which was expressed in a feeling of general emotional discomfort.

The respondents which were in the "middle" zone (12%) should already turn to a specialist who had to conduct an examination, including a conversation and a medical examination. Diagnosed depression was treated with psychotherapeutic and medication, under the supervision of specialists.

According to the method "How to measure personality. Sense of humor" (G. Eysenck, G. Wilson), the following dynamics was identified in adolescents in terms of the level of development of the reaction to recognizing a person to various types of jokes (see Fig. 1).
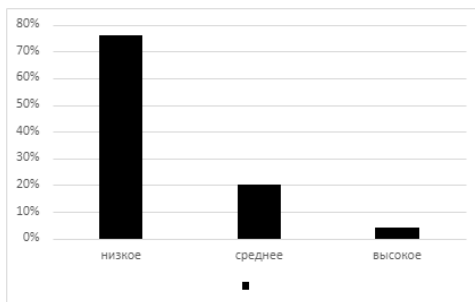
Figure 1 – Average values for the diagnosis "How to measure personality. Sense of humor" (G. Eysenck, G. Wilson)

The majority of the respondents (76%) did not present a tendency to find jokes funny, but this did not mean that this group of respondents did not have a sense of humor: they simply might have an unassuming taste. There were also respondents (20%) who had an "average" indicator - they would be people with a low tendency to evaluate and find jokes funny.

The respondents, who were in the "high" zone (4%), could be considered connoisseurs of jokes, and also found out what kind of personality traits they had. Explaining briefly, ectroverts preferred jokes which were sexually explicit and to some extent those that contained direct aggression; they were less fond of jokes with "nonsense" and "satire". Introverts had completely different indicators: they did not like aggressive jokes; they preferred cognitive humor, which was, "nonsense" and "satire". Stubborn, tough people often score high on "aggressive" humor; compliant, soft people usually don't like such jokes.

Conclusion. According to the hypothesis which was put forward, it was proved that there was a relationship between the level of depression and the sense of humor in the period of early adolescence, partially proved (rs = 0.359, while p ≤0,05) the relationship between the sense of humor and different levels of depression in the period of early adolescence was not manifested in fully. Therefore, the period of early adolescence is not sensitive for the development of depressive conditions. Unfortunately, the development of a sense of humor is very low, which negatively affects the formation of a positive attitude towards life among young people in general.

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Аннотация. Согласно исследованию было выделено, что существует взаимосвязь между уровнем депрессии и чувством юмора в период ранней юности доказана частично (rs = 0.359, при p ≤0,05). Ранняя юность не является сензитивным периодом для развития депрессивных состояний. К сожалению, очень низко развитии чувство юмора, что негативно влияет на формирование позитивной позиции к жизни в целом у молодых людей.

Ключевые слова: ранняя юность, депрессия, чувство юмора.

Annotation. According to the study, it was stated that there was a relationship between the level of depression and a sense of humor in adolescence was partially proven (r = 0,359, while p ≤0,05). It was noted that Early youth was not a sensitive period for the development of depressive states. It was concluded that the development of a sense of humor was very low, which negatively affected the formation of a positive attitude to life in general in young people.

Keywords: early youth, depression, sense of humor.

SECTION 9: PHILOLOGY
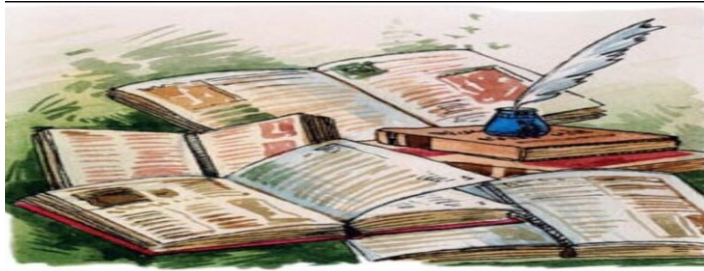
UDC 811.111

LEXICAL AND SEMANTIC, FUNCTIONAL AND STYLISTIC PECULIARITIES OF WORLD AUTOMOTIVE BRANDS ADVERTISING SLOGANS

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Introduction. Contemporary linguists are increasingly turning to the advertising subject, as it is one of the brightest means of displaying human communication in a society that is increasingly experiencing the large-scale influence of the mass media. Scientists focus on technologies that can convince consumers of the need to purchase new products. But advertising is a historical phenomenon and becomes outdated very quickly. Influence technologies are also changing; new means of persuasion are being introduced. Therefore, advertising still requires further study of innovative means of influencing the mass consciousness, extralinguistic and linguistic.

Until now, there are no systematic studies of the English advertising text in accordance with the types of advertised products, the problems of subordination of the lexical and semantic, structural and grammatical, functional and stylistic characteristics of the advertising slogan (AS), including the English-language, its communicative-pragmatic purpose, remain vague, which in the context of a contemporary linguistics communicative and functional orientation is of particular importance. The above-mentioned determines the need to study the verbal peculiarities of commercial advertising texts, including the automobile advertising slogans.

The research goal is to reveal and characterize the lexical and semantic, functional and stylistic peculiarities of world automotive brands advertising slogans.

The actual research material consists of 200 English-language automotive brands commercial advertising slogans, that function in contemporary world advertising space.

The main part. Automotive advertising text is a polycode structure, since it combines a units of different semiotic systems – word, font, color, sound, graphics, picture, multimedia, etc. [1, p. 11].

An advertising slogan is the core component of an advertising message. The slogan as a laconic motto of an automobile company performs the function of persuasion, forming a certain image in the recipient associated with the advertised car. He reveals a gravitation towards autonomy, specificity of content and form, as well as multiple repetition in advertising series of the same brand. The combination of such specific characteristics in the slogan creates a complete picture of the advertising message, enhancing the pragmatic impact on the addressee.

In the process of creating an advertisement, the addressee, first of all, focuses his message on a specific consumer group. The advertising creator predicts the expected audience reaction to the message, simulates the process of text perception by the recipient. This is largely determined by the purpose of the advertising text - to interest the addressee in the properties of a particular item and thus induce the addressee to purchase it or use it. It is this goal that determines the use of exclusively positive evaluations of the object in the advertising text, which will affect the addressee's positive choice of the advertising subject.

Thus, the category of assessment, implemented by various language means, is the semantic core of advertising texts. It is value judgments that, first of all, affect the addressee and push the recipient of information to become interested in a certain advertising object in order to select it in the future, that is, to realize the final goal of the addressee [2, p. 6].

In slogans, lexical and semantic groups of words with a positive connotation are most often activated, expressing sensory perception: *dream, love, pleasure, perfection*. For example: *Toyota: Drive Your **Dreams**; Audi: Everyone **dreams** of an Audi; Buick: **Dream** Up; Honda Cars Slogans: The Power of **Dreams**: It must be love; Volkswagen, the German car brand: For the **love** of the car; BMW Mini: Is it **Love**? Lexus cars (a Division of Toyota Motor): The Passionate Pursuit of **Perfection**; The Relentless Pursuit of **Perfection**; Peugeot: Live the **pleasure**; BMW. Sheer Driving **Pleasure;** Volkswagen Golf. One of the greatest **pleasures** you can have; Peugeot. Live the **pleasure**.*

Very often lexemes are used that emphasize the status of the car: *luxury (Lincoln: What a **Luxury** Car Should Be; Acura cars (the Honda Motor's brand) Ad slogans: The True Definition of **Luxury**. Yours),*

perform, performance (Nissan Primera. Designed to improve your **performance***; Acura. Precision Crafted* **Performance***; Jaguar. The art of* **performance***; Jaguar. Born to* **perform***)*.

Modern advertising mainly appeals to the emotions of the addressee, which is ensured by the use of certain emotionally colored words: *emotion, passion, excitement* etc, e.g.: *Seat. Auto emotion; FIAT: Driven by passion. FIAT; Pontiac: We are driving excitement.*

There is a predominance of lexemes with the semantics of anthropomorphic and animated action. This is primarily manifested in the incentive slogans: *Saab. Move your mind! Jaguar. Don't dream it. Drive it!*

Gender characteristics are generally not inherent in automotive advertising, but we still find isolated examples. Say, emphasizing the advantages of a car designed specifically for real men: *Mazda B2500 Fighter: Mazda Fighter. Men only; Volkswagen GTI Tagline: Volkswagen GTI. For boys who were always men.*

The implementation of the main goal of the advertising slogan – to induce the purchase of a product / service – is facilitated by certain linguistic and stylistic means.

AS are always expressive and communicatively effective using the stylistic technique of the antithesis: *Seat Ibiza: Seat Ibiza. Different rituals, same spirit. Audi Sline: Audu Sline. More horses, fewer seconds; Mersedes Benz: Classic Style. Sportive Extras.*

In advertising slogans, comparisons are often used that emphasize the uniqueness, originality of the product: *Hodgson car dealer, Newcastle Slogan: Hodgson. As individual as you are; Ford: Conquer the ice.*

Stylistic marking provides expressiveness, unusualness of the advertising text and is manifested in the use of structurally simple metaphors (*hairpin turns*; *thanks to its generous panoramic sunroof; ingenious seating system; clever design; exciting drive*) and structurally complicated: a) multicomponent metaphors (*The Mazda 5 is quick, responsive and precise; its sleek, stylish looks stand out from the crowd*); b) expanded metaphors (*the Lexus GS doesn't just go from 0 to 60 quickly, but amazingly quietly* ←*go amazingly + go quietly; incredibly smooth, stable ride* ←*incredible ride + smooth ride; impeccably styled interior* ←*impeccable interior + styled interior; ... ... it is one of the countless innovations found on this premium luxury sedan* ←*premium sedan + luxury sedan.*

The metaphor mainly serves to enhance the brand image: *Audi Quattro cars Advertising slogan: It's a miracle but we've made it; Terrano II by Nissan air lines.*

We observe the combination of antithesis and comparison in advertising slogans: *Audi Slinecars Saturn: Like always. Like never before.* Very vivid and emotional AS, which combines metaphor, impersonation and pun *(jaguar = animal and Jaguar –car brand: Jaguar cars: Unleasha Jaguar!*

Most car companies position their car as a "friend" (*Opel Astra. The new men's best friend),* therefore, it is quite appropriate to use impersonation in advertising slogans: *Citroen, French car brand Slogan: Just imagine what Citroen can do for you.* Impersonation gives this advertising slogan a certain sexual connotation inherent in French advertising.

Most of all, hyperbole is used, which is due to the positioning of the goods by the best, brand image: *Hummer: Hummer. Like Nothing Else. Porsche: Porsche. There is No Substitute. Jeep cars Motto: Jeep. There's Only One. Fiat: The largest sunroof you have ever seen.*

The use of litota is not inherent in automobiles logans, because a purposeful reduction in the aesthetic or technical characteristics of cars contradicts marketing objectives, therefore, in our sample there is only one, but stylistically very expressive example of litota in the advertising slogan of a small "beetle": *Volkswagen Beetle Advertising slogan: Think Small.* Graduation is the stylistic technique that best encourages shoppers to purchase:*Chevrolet: Eyeit - tryit - buyit!*

Epithets mainly emphasize the competitive advantages of cars and / or accentuate the image characteristics of cars: *Dodge car brand Slogans: Dodge. Different. BMW: BMW. The Ultimate Driving Machine. Lincoln: What a Luxury Car Should Be; Mersedes Benz. Enjoy the Magical Gifts of the Season.*

The use of precedent phenomena is always an effective and, of course, efficient method of creating an advertising slogan. Among the precedent advertising slogans we see the following: *Skoda Favorit: Put your money on the Favorit.* The slogan uses a phraseological unit: *put sb's money on sb/sth* (*to bet that a particular horse, dog, etc. will win a rase* [4, p. 858]. The phraseological unit's periphery encourages the consumer to take action: *Dodge. Grab Life by the Horns.*

Conclusions. The slogan as a laconic motto of the car company performs the function of persuasion, forming in the recipient a certain image associated with the advertised car. It shows a tendency to autonomy, the specifics of content and form, as well as multiple repetitions in advertising series of one brand. The combination in the slogan of such specific characteristics creates a holistic picture of the advertising message, reinforcing the pragmatic impact on the recipient. The communicative and

pragmatic orientation of the use of certain lexical and semantic, functional and stylistic means in the slogans of automobile advertising is obvious.

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Аннотация. В статье рассматривается вербальная специфика англоязычных рекламных слоганов мировых автомобильных брендов. Выявлены лексико-семантические и функционально-стилистические особенности рекламных слоганов мировых автомобильных брендов. Описаны языковые средства, обеспечивающие реализацию коммуникативно-прагматической установки рекламного слогана.

Ключевые слова: реклама, рекламный слоган, мировые автомобильные бренды, языковые маркеры, лексико-семантические средства, функционально-грамматические особенности, коммуникативно-прагматическая установка.

Annotation. The article deals with the verbal specificity of the English-language advertising slogans of world car brands. The lexical and semantic, functional and stylistic peculiarities of world automotive brands advertising slogans have been revealed. The linguistic means providing the implementation of the communicative and pragmatic setting of the advertising slogan have been described.

Keywords: advertising, advertising slogan, world car brands, language markers, lexical and semantic means, functional and grammatical features, communicative and pragmatic attitude.

UDC 811.161.1
CAUSES OF CONFLICTS IN THE PROCESS OF INTERCULTURAL COMMUNICATION

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International communication has its own distinctive features; first of all, it is a communication between parties with different views of the world,

which often takes place in an aggressive environment. The concept of ethnicity/ethnic identity encapsulates cultural, environmental and behavioural factors that increase the risk of conflicts; hence it is crucial in the intercultural communication. In some parts of Europe, race is being abandoned in favour of ethnicity.

That's why it is necessary to make a compromise solution by putting forward arguments and consistently discussing further steps. National and cultural specifics determine the success or failure of professional communicative interaction, therefore, the study of interpersonal communication should be approached from ethnocultural positions.

Taking into account the peculiarities of the linguistic consciousness of representatives of different cultures substantiates the characterization of speech interaction between them as an act of intercultural communication [4, 7]. In order to implement effective intercultural communication, it is necessary to study the stereotypes of perception of specialists and the peculiarities of their speech behavior in various cultures.

The communicative competence was studied by A.V. Khutorskoy, S.G. Ter-Minasova, A.A. Verbitsky, I.A. Zimnyaya, J. Raven and others. According to scientists, "stereotypes are culturally determined and in a certain way ordered pictures of the world in the mind of a person. The important characteristics of stereotypes are their imprecision and emotional-evaluative nature. In cognitive linguistics and ethnolinguistics, the term "stereotype" was characterized by W. Lippmann, T.G. Stefanenko, J. Collen, Y.D. Apresyan, V.A. Ryzhkov, O. Yu. Semendyaeva, S.I. Korolev, A.V. Mikheev, L.G. Guslyakova and others.

S.G. Ter-Minasova argues that stereotypes contain initial knowledge about other peoples and other cultures and thus prepare the ground for communication with them, decreasing culture shock [9].

The issues of intercultural communication are studied by many scientists, are considered at conferences and symposiums [2, 3, 8].

The problem of sociocultural stereotypes as barriers to intercultural communication has been less studied. The aim of this article is to determine the main communication causes that arise in the process of intercultural communication, and ways to overcome them.

Stereotypes are national, although it is possible to find analogues in different cultures. Therefore, special attention should be paid to the use of certain terms, their ambiguity, taking into account ethnic identity. While generally consistent, stereotypes can differ in details that are important for productive communication. Stereotypes make it possible to obtain basic knowledge about stereotyped behavior and perceptions in different cultures in the context of intercultural communication as the relationship of opposing

cultural identities. This is very important for the implementation of the communication process without conflicts and awkward situations [5].

One should not rely on stereotypes in intercultural communication; they are considered to be a primary idea of the people, changing in the process of communication radically, which can provide a distortion of reality. Another reason for conflicts in the process of intercultural communication is the inability to highlight cultural information in the context of communication or the unwillingness to determine one's place in a foreign cultural environment. When a person is a member of different sociocultural groups, he/she has several identities at the same time [1]. Ethnic identity is ethnic awareness, the perception of oneself as a member of a certain ethnic community with value and emotional meanings.

Ethnicity includes common or social origins; a common culture or tradition that differs from each other but it keeps between generations; and a common language or religious tradition. In some parts of Europe and the United States, race and ethnicity are interchangeable. There are groups of people of African heritage in the US and UK such as Black, Black African, and African American. Terms such as "Black", "African" or "Black African" among people of African heritage can be both offensive and inaccurate [6].

These terms are heterogeneous, which diminishes the value of ethnic categorization and understanding the causes of ethnic differences. Table 1 characterizes the terms used in recent decades to describe ethnicity. Meanings obtained from Oxford English Dictionary, Oxford Encyclopedic Dictionary of English, Oxford Reference English. Researchers for ethnicity should use the most specific term appropriate for context and avoid derogatory words.

The table 1 describes the heterogeneity of the terms Black, Black African, and African American within ethnic identity. For example, in African Caribbean or African Kenyan or African Surinamese documents, ethnicity must be defined. The term "Black" should be phased out, except when used in a political context [6].

Speech stereotypes belong to the field of sociocultural stereotypes. Stereotypical phrases include communicatively meaningful information in the context of communicative interaction. Sociocultural stereotypes are associated with the correct choice of means in accordance with the purpose of the statement. This choice depends on the tradition and history of the people and implies studying of the rules of stereotypical phrases application. "The terms and concepts of ethnicity need to be explicitly defined to permit better understanding of research and to facilitate regional and international comparisons" [6, www].

Table 1. – Heterogeneity of terms Black, Black African, and African American.

Negro	The term *"Negro"* means the colour black in Spanish and it was used by White Europeans as a shortened form of the racial classification Negroid to characterize people of sub-Saharan African heritage. Until the mid-20th century this term was widely applied for African Americans. Nowadays the term *"Negro"* generally considered inappropriate and derogatory although it is used occasionally in some research works. In its current use, the term is "considered acceptable only when used by African origin people, in historical context, or in the name of organisations. The racial classification Negroid is also no longer widely accepted" [9, www].
Black	The term "*Black*" universally "refers to a person with African ancestral origins" [9, www]. In some cases, in politics or power struggles, the term *"Black"* "signifies all non-White minority populations" [9, www]. "The continuing use of this broad term in epidemiology and public health may reflect pragmatic reasons such as small study numbers. However, the need for simplicity should be weighed against the dangers of stereotyping and incorrectness" [9, www].
African [origin]	The name Africa terra –"land of the Afri" (or "Afer" singular) was used by Ancient Romans for the northern part of the continent, corresponding to modern day Tunisia. Nowadays the name Africa signifies the whole continent. The term *"African"* [origin] usually refers to a person with African ancestral origins in the context of scientific writing on race and ethnicity "who self identifies or is identified by others as African, but usually excludes those residents of Africa of other ancestry, for example, Europeans and South Asians and sometimes excludes North Africans, for example, Algerians" [9, www].
Black African	The term *"Black African",* used in the UK, refers to persons and "their offspring with African ancestral origins who migrated via sub-Saharan Africa. The term has a geographical meaning and a more general one" [9, www].
African Caribbean /Afro-Caribbean	The term *"African Caribbean /Afro-Caribbean*" when used North America and in Europe generally refers to people with African ancestral origins who migrated via the Caribbean islands. The term is used inconsistently in the UK. Sometimes it is used by researchers to identify "people who are Black and of Caribbean descent, others to refer to people of either West African or Caribbean descent" [9, www].

Source: [6, 10].

Furthermore, the concept of sociocultural stereotypes plays both positive and negative roles in intercultural communication. A person

experiences a "culture shock" when entering the unknown ethnic environment. It should be noted that studies on ethnicity and cultures have a scientific potential in determining the causes of conflicts, explaining the interaction between cultural factors and stereotypes.

But, on the other hand, stereotypes possess enormous heterogeneity, which reduces the value of ethnic categorization and understanding the causes of ethnic differences, which leads to communication barriers, conflicts and awkward situations. To avoid this, one should take into account the ambiguity of stereotypes in a certain socio-cultural environment.

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Аннотация. Рассмотрены основные причины конфликтов в межкультурном общении. Следует уделять особое внимание применению некоторых стереотипных представлений, их неоднозначности с учетом этнической идентичности в межкультурной коммуникации. Совпадая в целом, стереотипы могут различаться, что имеет значение для продуктивного общения.

Ключевые слова: межкультурная коммуникация, конфликты, социокультурные стереотипы.

Annotation. The main causes of conflicts in intercultural communication are considered. Special attention should be paid to the application of some stereotypical ideas, their ambiguity, taking into account ethnic identity in the process of intercultural communication. While generally consistent, stereotypes can vary, which is important for productive communication.

Keywords: intercultural communication, conflicts, sociocultural stereotypes.

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INTERCULTURAL APPROACH TO FOREIGN LANGUAGES LEARNING

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Radical changes in the social life of our country, its rapid entry into the world community have made languages a real means of various types of communication [10]. Communicative interaction is represented by an idea process that determines the cognitive activity of participants of communication and generalized knowledge formation.

Research on intercultural communication, ethnicity, and health is growing in the world [1]. Currently, many scientists study communicative linguistics: J. Searle and J. Austin, I.A. Sternin, A.A. Zalevskaya, A.P. Martynyuk et al. Communication as an effort aimed at establishing common guidelines within the framework of interaction was considered by A.V. Kravchenko. Distinction between culture and ethnicity and race wereresearched by Charles Agyemang, Raj Bhopal, Marc Bruijnzeels, Sana Loue, Klaus Desmet, Ignacio Ortuño-Ortín, and Romain Wacziarg. Scientists Spencer Caplan, Jordan Kodner, Charles Yang studied the language as a means of communicative functional efficiency. The importance of foreign language proficiency for communicative competence was noted by Maria Rydell [12]. Desmet Klaus characterizes ethnic identity by relying on either ethnic or linguistic classifications and he proved that cultural as well as ethnic diversity affects the provision of public goods. A developmental perspective in recognition and repair of communicative failures was proposed by Francesca Marina Bosco, Monica Bucciarelli, Bruno G. Bara [2].

While there is a conceptual distinction between race, culture, and ethnicity, these terms are often used interchangeably or as synonyms. "The subjective components of culture, such as beliefs, values, and explanatory cognitive frameworks, are communicated both verbally and nonverbally…" [13, www].

Esteban, Mayoral, and Ray [6] studied how civil conflict is related to ethnic division, group inequality, and between ethnic polarization. Likewise, Esteban and Ray [5] researched the role of income inequality within ethnic groups as an identifier of civil conflict.

"First, ethnolinguistically heterogeneous societies may have more diverse preferences and values, leading to increased overall antagonism and conflict (in this case, CF should predict conflict). Second, ethnolinguistic fractionalization may matter per se because of direct animosity, hatred, or

barriers between different ethnolinguistic groups (in this case, ELF should predict conflict). Third, civil conflict may arise more frequently when ethnic divisions and cultural differences reinforce each other (in this case, $\chi 2$ should predict conflict)" [4, p. 2502].

Communicative linguistics is represented by such areas as the theory of speech acts [3], contrastive linguistics and the theory of intercultural communication. Recently, the subject of active linguistic research has become interest in intercultural communication and national characteristics of communication (Gonga Yang, Hub Xiang Laic Chun) [7].

This paper calls for debate on appropriate terminologies for different cultures speakers. Any language should be studied along with nations culture. Therefore, the knowledge level of a foreign language is determined by the possession of communicative skills, as well as compensatory competence within the framework of cognitive-communicative interaction of representatives of different cultures [8].

The problems of human communication in the context of language as the main means of one must be studied, since the mixing of languages, cultures has reached unprecedented proportions. The issue of tolerance has become relevant nowadays all over the world [9].

Table 1 shows the share of regressions where ethnicity dummies are significant at the 5 percent level, breaking down these results by region".

TABLE 1—JOINT SIGNIFICANCE OF ETHNOLINGUISTIC DUMMIES IN QUESTIONS FROM THE WORLD VALUES/
EUROPEAN VALUES INTEGRATED SURVEYS, BY REGION

	Number of regressions	Share of regressions with jointly significant ethnic dummies	R^2 without ethnic dummies	R^2 with ethnic dummies	ΔR^2
Whole sample	21,467	0.430	2.681	4.065	1.384
Africa, of which	3,623	0.548	2.468	4.064	1.597
Sub-Saharan Africa	2,724	0.616	2.369	4.274	1.905
North Africa	899	0.344	2.766	3.430	0.663
Europe, of which	7,769	0.373	3.045	4.144	1.099
Western and Southern Europe	2,369	0.313	3.567	4.399	0.832
Eastern and Central Europe	5,400	0.399	2.816	4.032	1.215
Asia, of which	5,654	0.572	2.334	4.486	2.152
East and Southeast Asia	2,088	0.626	2.092	4.526	2.434
South Asia	852	0.667	2.899	6.363	3.463
Southwestern and Central Asia	1,511	0.479	2.223	3.391	1.168
Middle East	1,203	0.525	2.494	4.464	1.971
America, of which	3,749	0.235	2.480	3.188	0.708
North America	741	0.513	3.157	4.075	0.918
Latin America and Caribbean	3,008	0.166	2.313	2.970	0.656
Oceania	672	0.342	3.669	4.509	0.840

Notes: North America is defined here as Canada and the United States. Mexico is included with Latin America and the Caribbean. R^2 is expressed in percentage terms.

Source: [4].

Understanding principles and methods of using language in communicative interaction constitutes a significant part of the knowledge base of a culture speaker.

The use of language as a means of communication is impossible without the presence of general principles that ensure mutual understanding of communicative interaction [9]. It is necessary to be ready to the emergence of

communication failures and possess the ability to solve these problems in order to avoid interpersonal conflicts [11].

The concept of communicative failure in the interaction between representatives of different cultures is associated with the concept of a foreign speaker's error in the perception of speech.

Communication failures are classified into following:

– technical, such as incorrect phonetic or graphic structure of speech. This communication failure is the result of poor knowledge of foreign phonetics, spelling and graphics;

– systemic, as a result of non-acquaintance of the system of linguistic meanings and ways of expressing, or the ambiguity inherent in the language system itself (homophones, polysemy, etc.).

– inferential as incorrect restoration of implicatures (from Latin "Implicatio"– communication), when information is present in a hidden form, but is not explicitly expressed;

– discursive errors – non-acquaintance by the system of cultural norms and values (etiquette errors, social-role aspects of communication, socio-cultural stereotypes of speech communication).

– encyclopedic – non-acquaintance of the word meaning, etc.

"Following the tenets of Cognitive Pragmatics, a theory of the mental processes underlying the comprehension and production of communicative acts", there is an original taxonomy of the different a types of failure which may occur in communicative interaction: Failure of the expression act, Failure of the actor's meaning, and Failure of the communicative effect [2, www].

Conclusion. "Ethnolinguistic fractionalization is insignificant, and has an unstable sign across specifications, although it tends to bear a negative sign when all measures of heterogeneity are entered together.." [4, p. 2504]. Overcoming socio-cultural stereotypes, in the paradigm of an intercultural approach to teaching foreign languages, is based on the formation of a conscious attitude to stereotypes by creating a general orientation basis for activities.

For effective interaction between representatives of different nationalities and languages, it is not enough to study lexical units and grammatical structures of a foreign language. The dialogue of cultures is important [10], when the participants achieve complete mutual understanding. In order to avoid communicative failures, which could be the cause of conflicts it is necessary for the communicant to master the essential facts, norms and values of another culture while maintaining national and cultural identity – tolerance, respect for other cultures.

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Аннотация. В статье изложены основные особенности межличностного коммуникативного взаимодействия. Рассмотрены коммуникативные неудачи между носителями разных культур. Цель данной работы – обсуждение вопросов применнения терминологии для носителей разных культур.

Ключевые слова: иностранный язык, носители разных культур, межкультурная коммуникация, коммуникативные неудачи, межличностные отношения, социальные стереотипы.

Annotation. This paper outlines the main features of interpersonal communicative interaction. The communicative failures are considered between different cultures speakers. This paper calls for debate on appropriate terminologies for different cultures speakers.

Keywords: foreign language, different cultures speakers, intercultural communication, communication failure, interpersonal, social stereotypes.

UDC 811.111
FUNCTIONAL FEATURES OF MARINE TERMINOLOGY
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Introduction. Today, the development of a cognitive approach to the phenomena of language is especially essential. Linguistic forms are considered as derivatives of the conceptualization of the world by human consciousness, and their meanings – as certain structures of knowledge. The need to analyze the peculiarities of nominating nautical terms in the English language is due to the fact that it allows to identify the features of the

corresponding lexical systems, as well as the correlations between conceptual models of speakers [5].

A an the Great Britain is a nation, the realities of the sea have always been paramount. Economic development and the prosperity of the kingdom have always depended on the success of the English fleet in naval battles. The commercial and cultural relations of the United Kingdom were mainly associated with the sea. Therefore, the analysis of marine terminology, its functional features allows to obtain information about one of the most significant fragments of the picture of the world of native English speakers. Marine terminology has a significant place in the vocabulary of native English speakers [1].

The main part. The purpose of this article is to consider the functional characteristics of marine terminology, which contributes to a deep understanding of the processes of communication and the systemic organization of the vocabulary of the English language. The object of the research is the English marine terminology.

The material of the study was the dictionary of modern English by Longman, Glossary of Shipping Terms [4], works by David C. Plaut [6].

Distinctions in the function of the lexical systemas manifest in the behaviour of experimental subjects were studied by M. Coltheart, M.J. Farah, J.L. McClelland, E. Funnell, R.A. J.J. Jacobs, A.H. Kawamoto, W.T. Farrar, C.T. Kello, J. Morton, K. Patterson, D.C. Plaut, D.E. Rumelhart, G.E. Hinton, , R.J. Williams, M.S. Seidenberg, J.L. McClelland, G.C. Van Orden, S.D. Goldinger, W.A. Wickelgren. Many scientists have researched the structural and functional features of marine terminology: O.G. Kozlovskaya, B.L. Bogorodsky, F.P. Sorokoletov, N.K. Garbovsky, S.D. Ledyaeva, O.S. Mzhelskaya, G.F. Odintsov, Kalanova, M.V. Popova, V. Ulanova, I.M. Chipani et al.

"A tremendous amount of data has been gathered on how various properties of a written word (frequency of occurrence, age of acquisition, numbers of letters and phonemes, orthographic neighbourhood, spelling – sound regularity and consistency, imageability, meaningfulness, prior context, etc.) influence the speed and accuracy with which a word is understood and pronounced by normally and abnormally developing readers, skilled readers and brain-damaged patients with selective reading impairments" [6, p. 2].

Distinctions among marine terms lead researchers to postulate additional structure in the lexical and functional system. Having analyzed the marine terminology, we came to the conclusion that there are the following functional features:

1. The expansion of the marine vocabulary is due to the complication of the conceptual sphere, reflecting the ideas of native speakers of English about floating facilities, because of new types of ships emergence: *salvage tug, product tanker, product/oil/bulk/ore-carrier, double-ender, anchor handler, stand-by ship, factory ship, longliner, seiner, semi-submersible vessel, drayage,* et al. e.g. ***Piggyback*** is a "transportation arrangement in which truck trailers with their loads are moved by train to a destination. Also known as Rail Pigs" [4, p. 80]. ***Piggy-Packer*** is a "mobile container–handling crane used to load/unload containers to/from railcars [4, p. 80]

2. The phenomenon of homonymy is present in marine terms. Most of the verbs and other parts of speech that convey concepts related to navigation are derived from the corresponding nouns:

– The electrical plant ***supplies*** all shipboard power needs, including propulsion. ***Supply*** chain ia a logistical management system.

– All vessels typically ***load*** vehicles aboard one or more decks via low-level side doors or by stern. ***Load*** line is the waterline corresponding to the maximum draft.

– Dry-bulk ships ***bear*** a superficial likeness to container ships. Although most polar ***bears*** are born on land, they spend most of their time on the sea ice; their scientific name means "maritime **bear**" and derives from this fact.

– Most ocean freight is ***billed*** on the basis of weight or measurement tons (W/M). Freight ***Bill*** is a "document issued by the carrier based on the bill of lading and other information; used to account for a shipment operationally, statistically, and financially" [4, p.50].

– "The Sea–Bee system ***facilitates*** forward transfer and positioning of barges" [4, p. 87]. Port ***Facility*** security officer is the person designated as responsible for the development, implementation, revision and maintenance of the port ***facility*** security plan and for liaison with the ship security officers and company security officers

– "During the quarantine period, the Q flag is ***hoisted***" [4, p. 85]. A ***hoist*** is a piece of equipment used for lifting heavy things;

3.Polysemy of terms, when one term is characterized by several meanings, various phenomena, social relations, etc.

"Terminal" means: 1) An assigned area in which containers are prepared for loading into a vessel, train, truck, or airplane or are stacked immediately after discharge from the vessel, train, truck, or airplane, e.g. Ramp is a "railroad *terminal* where containers are received or delivered and trains loaded or discharged" [4, p.85]; 2) forming, or situated at the end or extremity of something; 3) "a *terminal* date" (of a disease) predicted to lead to death, especially slowly; incurable; "*terminal* cancer"; 4) the end of a

railroad or other transport route, or a station at such a point; 5) "a freight *terminal"*, a point of connection for closing an electric circuit [3].

"Draft" means: 1) "the number of feet that the hull of a ship is beneath the surface of the water; 2) an unconditional order in writing, addressed by one party (drawer) to another party (drawee), requiring the drawee to pay at a fixed or determinable future date a specified sum in lawful currency to the order of a specified person" [4, p.40]; 3) "Depot, Container freight station or a designated area where empty containers can be picked up or dropped off" [4, p.38].

"*Consignment*" means: "1) a stock of merchandise advanced to a dealer and located at his place of business, but with title remaining in the source of supply; 2) a shipment of goods to a consignee" [4, p. 32].

"*Break Bulk:* means: 1) "to unload and distribute a portion or all of the contents of a rail car, container, trailer, or ship; 2) loose, non–containerized mark and count cargo; 3) packaged cargo that is not containerized" [4, p.22].

4. Common terms-phrases that appeared at the later stages of the development of the marine terminology system. Many of these phrases undergo contraction and become complex words: *barge-carrying ships,* freeboard, deckhouse, *dry-bulk ships, trusswork, athwartships, backhaul, carfloat, coastwise, seaworthiness, seawaymax, sea waybill, sea–bee vessels,* e.g.:

Pier–to–House is a "shipment loaded into a container at the pier or terminal, thence to the consignee's facility" [4, p.80]

Pier–to–Pier is a "containers loaded at port of loading and discharged at port of destination" [4, p.80];

5.The phenomenon of synonymy in marine terminology. In a terminological system, the existence of synonymy is usually the result of a different approach to the same object, different perceptions of the same phenomena:

– *Special equipment includes mooring winches to ensure accurate positioning of the ship under cranes in port and special tanks* **to list (tip)** *and* **trim (level)** *the ship to permit a symmetrical loading or unloading without excessive* **list or trim***;*

–*They checked the* **rigging** *before they set sail. Ship's* **Tackle** *is all* **rigging***, cranes, etc., utilized on a ship to load or unload cargo.*

–*Freighter* are **breakbulk** vessels.

–"*Sea–Bee Vessels Ocean vessels constructed with heavy–duty submersible* **hydraulic lift or elevator system** *at the stern of the vessel*" [4, p. 87].

6.The phenomenon of antonymy creates polar meanings. These poles are realized by words in the composition of marine terminology. Opposite processes between scientific concepts and professional activity are reflected in antonymic pairs:

–"**Roll-on/Roll-off** *vessels: Ships specially designed to carry wheeled containers or trailers using interior ramps. Includes all forms of car and truck carriers*" [4, p.91].

"Breakbulk vessels both **refrigerated and unrefrigerated***, containerships*" [4, p.91].

– Mooring winches trim the ship to permit a symmetrical **loading or unloading** *without excessive list.*

Conclusion. The main positions in this work are summarized as follows: the historical development of England was accompanied by the economic development and prosperity of England, which conquered more and more colonies. The concepts related to the fleet and the sea, occupy one of the most important places. All this was reflected in the marine terminology. "Gaining insight into the structure and function of the cognitive system by observing its normal and impaired behavior" [6, p. 36] is an essential goal of cognitive psychology. It depends on developing theories and explicit simulations that relates structure to function.

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Аннотация. Морская терминология занимает весомое место в лексиконе носителей английского языка, поэтому цель данной статьи – рассмотрение функциональных характеристик морской терминологии, что способствует глубокому пониманию процессов коммуникации и системной организации лексики английского языка.

Ключевые слова: морская терминология, английский язык, структурно-семантические особенности, когнитивный подход.

Annotation. Marine terminology occupies a significant place in the vocabulary of native English speakers; therefore the purpose of this article is to consider the functional characteristics of marine terminology, which contributes to a deep understanding of the communication processes and the systemic organization of the English vocabulary.

Keywords: marine terminology, English, structural and semantic features, cognitive approach.

COMPUTATIONAL THINKING IN EDUCATION SYSTEM

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Introduction

In out connected globalized world computational thinking became the most essential part of the modern life. Nowadays people face computer science not only on their workplaces, where they need to deal with work tasks, but also in their daily routine. That is why it is extremely vital to prepare students for this reality and include in the school curriculum elements of computer thinking, which consists of logical judgement, creativity, cooperativity and problem solving.

But schools and even universities are lack of computer thinking courses, so integrating computing thinking in the syllabus should become one of the main tasks for countries, if they want to compete on global economy.

Definition of computational thinking

There are a few definitions of computational intelligence exist. For example, Wing in his seminar paper define computational thinking as "taking an approach to solving problems, designing systems and understanding human behavior that draws on concepts fundamental to computing'' (Wing 2008) [2, p. 1]. Later it evolved into ''the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent'' (Wing 2011) [3, p. 22].

In addition to this, scientists believe, that computing thinking can be dispatched on some components, such as critical judgement, algorithmic approach, creativity, cooperation and tasks solving.

Computational thinking and problem solving

All areas of our life are able to be decomposed to simple tasks. Especially this approach takes place in the calculus, which fully consists of defining problems and then solving them. The biggest segment of the school curriculum is based on mathematics problem solving. That is why it is essential to teach students not only some basic skills, such as reading, writing, performing simple calculations, etc., but also computing thinking, that can be applied in every sphere of society [1].

As an example, I want to bring research, conducted by Swasti Maharani, Muhammad Noor Kholid, Lingga Nico Pradana, Toto Nusantara. They concentrated on comparing Polya's problem and computational thinking and seeking relationships between solving Polya's problems and stages of computing thinking.

They included 30 respondents from Universit as Negeri Malang, who studied mathematical education. They should have solved graph task. The question was "map can be easily represented by graph. A country symbolized by a vertex and edge (line between two vertexes) describes two neighboring countries on graph. The picture below represents a map into the graph. Specify an appropriate map for the given graph!" (Figure 1).
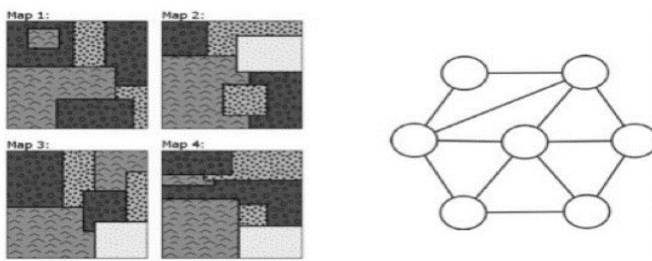

Figure 1. – A map into the graph

Research consisted of three phases.

The first one consists of respondent being asked to solve the task (the wording of the task is given above).

The second phase is observation. The scientists documented the respondent directly, and also they documented all respondent's actions in order to focus on which step of computational thinking student applies in order to solve the given problem.

The third phase is an analysis of constituents of students computing thinking, according to the direct observation. The results concludes, whether student have done some computational thinking steps or not.

The clue of computational thinking when solving the problem can be viewed on the Table 1.

Table 1. The clue of computational thinking

The constituent of computational thinking	Student performance
Abstraction	students are able to disunite main information from the additional one
Generalization	students are able to summarize general information
Decomposition	students are able to break down a complex problem into smaller and simpler ones
Algorithmic	students are able to come up with the idea of step by step solution of the problem
Debugging	students are able to find and fix mistakes in their solution

The final results prove that students use computational thinking in solving the given problem. They undertook five steps of computing intellection: decomposition, abstraction, generalization, algorithmic and debugging, which can be performed in a random order.

The student's ability to perform this steps differed in the terms of their grades, and differed substantially, but the relationship between gender and the level of computer thinking was not revealed.

So, all things considered, it is possible to make a conclusion, that student's knowledge of computational thinking helped them to solve mathematical task and achieve desired results.

How to accommodate computational thinking into the school curriculum

We found out, that accommodating computer intelligence into the school program is extremely important, and below I will suggest a few ways of doing this.

1. To develop already existing elements of computational thinking presented on the lessons. It may not be directly connected with computers, programming or data science. For example, in the physics lessons students are required to build models in order to understand objects or processes better. Teacher may connect the model and computational skills by provoking a discussion about what models are, how they are made, where they are applied.

2. More sophisticated way of integrating computing intelligence is to include special tasks, closely connected to the data science and skills. For example. students can be asked to collect and process data by themselves, analyze them and then create a presentation.

3. And the most advanced way is to set up special lessons and lectures, fully dedicated to the computational thinking and data science, where students would be told about current state of modern technologies and explained how to use them. There may be some programming courses, lectures about algorithmic approach and so on.

Difficulties and future perspectives

This suggestions sound very easy and obvious, but in reality teachers are need to deal with a great amount of problems. There are no precise curriculum with written guidelines and clear lesson plans, so teachers improvise. But this approach does not let to build a coherent picture of understanding the purpose and sense of computational thinking.

There are a list of problems teachers can face while teaching computing intelligence.

1. The lack of clearly defined computational thinking competences for each form. What is currently missing from the literature is how CT skills, such as abstraction, problem decomposition, and data structures, might map to different abilities, grade level, disciplines, gender, and educational level.

2. No understanding how to teach students effectively and efficiently.

3. The lack of needed hardware. A great amount of schools and even universities are underequipped with computers and other electronic devices needed to present computational skills.

4. The lack of teacher's professional development in the sphere of computational thinking education. Teachers need to be systematically prepared to teach computing intelligence, but on the current lever there is no such a possibility.

5. Unclear assessment of computational skills. There are no guidelines on how to assess creativity, abstraction thinking, critical thinking and other components of computing intelligence.

Conclusion

All in all, although there is a general believe, that integrating computational thinking into the school curriculum is extremely vital task, which should be a top priority for modern countries, government put too little effort in doing this.

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Аннотация. Этот доклад рассказывает об обучении компьютерному мышлению в системе образования. В современном мире высоких технологий и обилия информации невероятно важно подготовить учеников к жизни и работе в текущих условиях. По этой причине компьютерное мышление, которое определяется как совокупность таких навыков, как алгоритмическое мышление, кооперация, креативность, критическое мышление и умение решать проблемы, должно быть включено в образовательные программы. В статье рассмотрены пути, с помощью которых компьютерное может быть включено в обучение. Также статья рассматривает проблемы, с которыми могут столкнуться преподаватели при обучении студентов компьютерном мышлению.

Ключевые слова: компьютерное мышление, алгоритмическое мышление, система образования, обучение студентов, интеграция в учебную программу.

Annotation. This article talks about computational thinking in education system. In our modern globalized world it is extremely vital to prepare students for living in the world of modern technologies and informational society. Due to this reason, computational thinking, defined as algorithmic thinking, cooperativity, creativity, critical thinking, and problem solving, must be integrated into Science Curriculum. The article overlooks

the ways it may be implemented for students at all levels of education. In addition to this, the article reviews the problems teachers may encounter while teaching computational thinking skills.

Key words: computational thinking, algorithmic thinking, education system, educating students, integration into science curriculum.

THANK YOU FOR YOUR PARTICIPATION!