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Foreign Languages Department

**Recent Achievements and Prospects  
of Innovations and Technologies**  
Proceedings of IX All-Russian Science-Practical Conference of  
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«Достижения и перспективы инноваций и технологий»  
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студентов, аспирантов и молодых учёных  
(г. Керчь, 6 мая 2020 г.)  
*к 75-летию Победы в Великой Отечественной войне*



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В сборнике содержатся материалы докладов, рассматривающих теоретические и практические вопросы инновационных технологий, проблемы сохранения и трансляции культурной памяти, экологии и защиты окружающей среды, военного перевода, педагогики, психологии и др. Конференция посвящена 75-летию Победы в Великой Отечественной войне.

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**THANK YOU FOR YOUR PARTICIPATION!**

## INTRODUCTION



Source:[https://yandex.ru/images/search?text=recent%20technological%20advances&from=tabbar&p=1&pos=35&rpt=simage&img\\_url=https%3A%2F%2Fsmartsafety-hub.hima.com%2Fwp-content%2Fuploads%2F2019%2F12%2FiStock-1013969318-klein-1.jpg](https://yandex.ru/images/search?text=recent%20technological%20advances&from=tabbar&p=1&pos=35&rpt=simage&img_url=https%3A%2F%2Fsmartsafety-hub.hima.com%2Fwp-content%2Fuploads%2F2019%2F12%2FiStock-1013969318-klein-1.jpg)

Crucial determinant of longterm success will be the sustained development of innovative new and services. Innovation is the process of translating an idea or invention into a good or service that creates value. An idea must be replicable at an economical cost and must satisfy a specific need. Innovation involves deliberate application of information, imagination and initiative in deriving greater or different values from resources, and includes all processes by which new ideas are generated and converted into useful products.

Global competition is increasingly shifting to science, technology and education. It would appear that rapid digital transformation and technologies that are quickly changing industries, markets and professions, are designed to expand the horizons for anyone who is willing and open to change. In order to achieve high growth rates, it is also necessary to solve systemic problems to strengthen the potential of science, to form unique technological reserves

The IX All-Russian Science-Practical Conference of Students, Postgraduates and Young Scientist “Recent Achievements and Prospects of Innovations and Technologies” will be a part of the efforts to develop new technologies. This Conference is future specialists’ platform to grow and network with likeminded researches all over the world.

The famous Australian scientist, Doctor, Associate Professor, medical scientist and health journalist Tim Crowe addressed to the participants of the conference:

“Greetings from Australia. Welcome to the on-line conference “Recent Achievements and Prospects of Innovations and Technologies”. I am working in the areas of teaching and research in the field science of nutrition. It’s wonderful that so many students are interested in disciplines of Engineering Innovation Processes, Information Systems, Marine Technologies, Actual Problems of Economics, History, Theology, Sociology, Psychology and Pedagogy . I wish you the very best productive studies”.

## The conference was held online

**The main characteristics**

- The crew - 2 people
- The wingspan - 14,6 m
- The wing area - 38,5 sqm
- Height - 3,5 m
- The weight of empty machine - 4200 kg
- The weight of flight - 5340 kg
- Armament: 2 x 23 mm guns (VV), 12,7 mm Berezin machinegun, 400 kg of bombs, 8 x PC.
- Max. speed - 402 km/h
- Max. height - 4000 m (3000 m in 8,8 min)

**The aim of the work**

Tell about one of the most important "weapons of Victory" of the Soviet Union in the great Patriotic War.

**Tasks**

- To present to the public the most interesting and recognizable facts about this weapon
- To tell history of the creation of this weapon
- To give its technical characteristics and compare it with its contemporaries
- To provide a brief biography of the developer
- To tell about the production and application conditions



Construction of B-2




**Yan Kalinkin** –National Research Tomsk Polytechnic University



1
2
3

1. **Veronika Lekareva** Sevastopol State University
2. **Viktoriya Steba** – Sevastopol school N 29
3. **Alexey Sorokin** –Tomsk Polytechnic University

**New challenges**

The nature of the action has changed. The need to adapt



**New helmets required**

There was many helmets in different countries.






**Alexander Fedotov**–National Research Tomsk Polytechnic University

**Introduction**

We are going to celebrate one the most important dates in the history of our country the **75th 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 many weapons to defend the country. For example, it was necessary to produce tanks for the army.

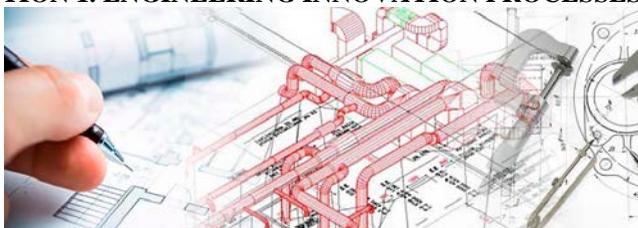
**The T-34 tank has become the symbol of the Great Patriotic war.**

**75th Anniversary of the Victory in the Great Patriotic War**



**Natalia Werner** – Tomsk Polytechnic University, Tomsk

## SECTION 1. ENGINEERING INNOVATION PROCESSES



UDC 621.331

### OVERVIEW OF WIRELESS POWER TRANSMISSION SYSTEMS

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### INTRODUCTION

The relevance of the development of various energy transmission systems is connected with the fact that human life today in many matters is associated with electronic devices that have a battery in their configuration. These devices often have low battery capacity and require frequent recharging. Thus, every day there is a need to use various kinds of energy transfer standards to power or recharge multiple devices. There are a

number of different energy transmission systems in the world that can be generally divided into two classes, wired and wireless. Wired electrical energy transmission systems include energy transmission systems, the conductors of which are wires in insulation (wires). Wireless systems include power transmission systems in which there are no conductive connections, which is their main advantage. The main disadvantages of wireless systems include, firstly, severe heating losses. This drawback implies that in the process of recharging, there is a need for a complete docking of the mechanisms of reception and transmission of energy. The second equally important drawback of wireless power transmission systems is the constant energy consumption of the system. This disadvantage implies that in the absence of a charging device near the charging station, the radiation of energy by the transmitting element, as well as its consumption will be carried out in the same volume as in the presence of the device. Energy will be radiated into space in the form of a simple heating of air. In this matter, there is the safety of organisms that fall into the scope of the system. This article discusses existing wireless power transmission systems and their listed disadvantages.

#### **Existing wireless energy transmission methods**

Consider magnetic resonance technology. A simplified equivalent circuit assumes the presence of two magnetically coupled coils. This technology is not critical to the mutual arrangement of coils. But here the distance between the receiving and transmitting coils is critical. To achieve better efficiency, the resonant frequency that best interacts with the load resistance is selected. With precise matching in magnetic resonance technology, energy transfer occurs with the highest efficiency. In practice, there are many companies developing wireless energy transmission systems of various standards based on this technology. To date, two standards for wireless power transmission are relevant. These include Qi - the most common wireless recharging standard developed today by the consortium of wireless electromagnetic energy.

Coils form an inductive coupled system. Alternating current flowing in the winding of the primary coil creates a magnetic field that induces voltage in the receiving coil, which can be used both to charge the battery and to power the device. As the secondary coil moves away from the primary, a larger part of the magnetic field is scattered and does not reach the secondary coil. Even at relatively short distances, inductive coupling becomes ineffective. Figure 1 shows the values of the coupling coefficient ( $k$ ) with a distance between the coils of 0.2; 2.5; 5; 7.5 and 10 mm, and also presents graphs of the dependence of the coupling coefficient on the magnitude of the displacement (for coils with a diameter of 30 mm).

Inductive coupled resonant circuits used in wireless charging systems have been used successfully in various radio engineering devices for decades, and their theory has long been well known. The energy transfer efficiency of the system depends on the coupling coefficient between the coils and their quality factor. To increase the efficiency of wireless charging systems, the phenomenon of resonance should be used, which allows to increase the efficiency and range of energy transfer. It is possible to increase the efficiency of inductively coupled systems by increasing the quality factor of coils or the coupling coefficient.

The second standard is PMA - introduced by Powermat in 2012. Some devices may support the formats of two of the above standards. The only difference between these standards is the frequency of operation.

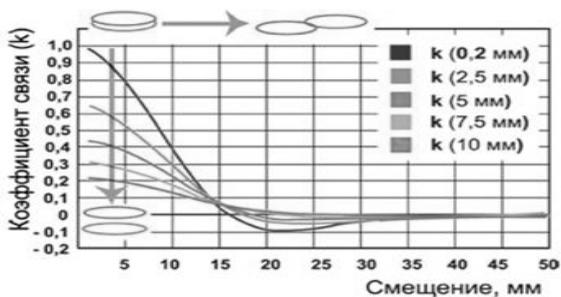


Figure 1 - Graphs of the dependence of the coupling coefficient on the displacement of the coils

The Qi format operates in the frequency range 100-205 kHz, and the PMA standard is 277-357 kHz. Operating at relatively low frequencies, much lower than their resonant frequency, antennas have a small gain and cannot be used as energy transformers, although they are used. The even less popular A4WP wireless power transmission standard is Alliance for wireless power. This standard is the latest development, which has a distinctive feature. In their standard, participants in the Alliance for Wireless Power industrial alliance realized the effect of magnetic resonance when the emerging magnetic field is transferred from one coil to another, rather than magnetic induction like its competitors. This technology was called Rezence and is positioned by the creators as the technology of the "next generation". The name "Rezence" comes from two words: "resonance" (resonance) and "essence" (essence), which reflects the principle of technology. The standard allows wireless transmission from 1 to 50 watts., Which may be enough to charge not only a smartphone, but

also a light laptop, tablets and other consumer devices. In theory, Qi provides charging with a power of up to 5 W and a current of 1 or 2 A, at a voltage of 5 V. These parameters are comparable to wired chargers, but the power goes much slower. Based on the above, it is clear that this technology includes emits energy into space in the absence of a rechargeable device, thereby creating a threat to the occupants of the room.

### **Proposed decision**

In the development, it is proposed to use microstrip technology for wireless energy transfer [1]. The energy transfer system, patented by the authors and consists of two symmetrical identical parts, each of which is a microstrip transmission line of a certain length, shorted or open at one end and excited from the other end. The line is twisted into a spiral shape to exclude the dependence of the transmission coefficient on the orientation of the structures relative to each other. To prevent unproductive energy losses in structures, a coordinated load of 50 Ohms (or any other resistance) is used. Microstrip structures do not emit electromagnetic energy into free space; This is an absolutely proven fact. Accordingly, there are no unproductive energy losses. The claimed system provides energy transfer at reasonable distances between microstrip structures. So, at a limit distance of 30 mm between the structures, the transient attenuation does not exceed a value of 10 dB. At working distances of 5-10 mm, the transition attenuation during wireless energy transfer does not exceed 1 dB. Strip lines are placed on dielectric substrates of a dielectric with a permeability  $\epsilon = 4.3$  and  $\tan\delta = 0.005$ . The thickness of the substrates for the system with the specified parameters is 3 mm. The total length of both strips is about 1 m, the width was 10 mm, and their thickness was 30  $\mu\text{m}$ . The size of both substrates corresponds to an area of  $200 \times 200 \text{ mm}^2$ . The use of spiral microstrip lines significantly reduces the size of electromagnetic structures and opens up good opportunities for reducing the requirements for the relative positioning of elements of a wireless energy transmission system. Also, this system is fully scalable, which allows it to be used both for recharging household (low-consumption) devices and for electric vehicles.

### **CONCLUSION**

Thus, the article discusses the most common standards for wireless energy transfer, identifies their advantages and disadvantages. It is clear that inductive systems of energy transfer are limited in terms of power characteristics and carry a danger to humans, which makes it inefficient and dangerous for humans. A wireless energy transmission system is described that does not radiate energy into free space and is compact, economical, and most importantly, safe.

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**Аннотация.** В статье представлен обзор существующих методов беспроводной передачи энергии. Также представлены преимущества и недостатки указанных выше систем. Предложена система беспроводной передачи энергии, функционирующая на расстоянии 5..30 мм. Система является высокоэффективной, может функционировать на высоких мощностях (десятки кВт) и может быть использована для системы беспроводной подзарядки аккумуляторных батарей.

**Ключевые слова:** система беспроводной передачи энергии, подзарядка, обзор методов.

**Annotation.** The article provides an overview of existing methods for wireless energy transfer. The advantages and disadvantages of the above mentioned systems are also presented. A wireless energy transmission system is proposed that operates at a distance of 5..30 mm. The system is highly efficient, can operate at high powers (tens of kW) and can be used for a wireless battery recharging system

**Keywords:** wireless power transmission system, charging, methods overview.

UDC 621.331

## STRIP LINE ENERGY PARAMETERS CALCULATION FOR WIRELESS ENERGY TRANSMISSION SYSTEM

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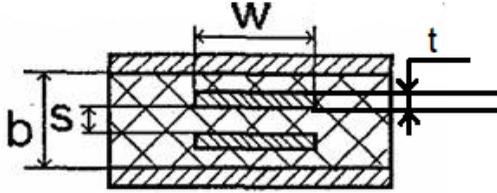
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## **INTRODUCTION**

Widespread in our time have received various energy transfer systems. In the 20th century, power transmission systems based on wired technology became very popular. These systems have several advantages, the main of which is the minimum amount of energy loss due to the use of conductive materials as a medium for energy transfer. Currently, a new type of energy transmission system is widely used - wireless. Wireless power transmission systems are widely used because they have several advantages, the main one being the absence of wires, which means that a dielectric medium, such as air, can be used as a medium for transmitting energy. Previously, the authors of the article presented a review article on existing methods and standards for wireless power transmission, in which their advantages and disadvantages were described. A variant of a wireless power transmission system has also been proposed in which there are no disadvantages of existing systems. At the first stage, confirming the relevance and functionality of the proposed system, it is necessary to carry out computational calculations, as a result of which it will be possible to obtain theoretical values of the efficiency parameters of the proposed system, as well as from which it will be possible to formulate requirements for the physical parameters of the electromagnetic structure.

In a previous article, the authors proposed a wireless power transmission system for the task of wirelessly recharging the batteries of unmanned aerial vehicles (UAV). On average, the battery capacity of the UAV, with a flight duration of 30-50 minutes, can be 1 W / h, which means that with a power of 1 W, this battery will charge in one hour, respectively, with a power of 2 W - in half an hour, etc. As the power  $P_1$ , which is supplied to the first structure, we take the value of 5 W, based on the fact that performing tasks in the field, the drone needs to quickly recharge the battery and continue to carry out its task. As a transceiver system, the authors proposed to use a microstrip structure, which, when approaching the second structure, forms a strip structure, shown in Pic 1, based on which a functioning fragment of a directional coupler is obtained [1].



Pic. 1 — Strip line view

For convenience, we assume that the substrate material is made of a material with the same dielectric constant ( $\epsilon = 1$ ) and the same loss tangent ( $\tan\delta = 0$ ) as the energy transfer medium, namely air. As such a material, foam (foam) was selected. According to the UAV dimensions, the appropriate dimensions of the electromagnetic structure were chosen for which the strip width  $W = 220$  mm, the distance from the structures taking into account the substrate  $b = 15$  mm, the distance between the metalized layers of the structures  $S = 5$  mm, and the thickness of the metalized layer  $t = 0.3$  mm. The frequency of the system was chosen based on cost and size restrictions so that both of these parameters were acceptable. Based on this, it was decided to choose a system operating frequency of 200 MHz. To calculate the parameter of the efficiency of energy transfer from one structure to another, the transmission coefficient ( $S_{21}$ ) is used, which is determined by the formula:

$$S_{21} = 10 \cdot \log_{10} \left( \frac{P_2}{P_1} \right);$$

where  $P_1$  is the power of the radiated structure, and  $P_2$  is the power of the received one [2]. To determine the power of  $P_2$ , this formula was chosen based on the physical parameters of the structure. This formula is as follows:

$$P_2 = \frac{P_1 k^2 \sin^2 \theta}{1 - k^2 \cos^2 \theta};$$

In this formula:  $\theta$  is the electric length of parallel-connected sections of the line, is determined by the formula:  $\theta = kd = 2\pi df$ , and  $k$  is the coupling coefficient, defined as:

$$k = \frac{Z_{oe} - Z_{oo}}{Z_{oe} + Z_{oo}};$$

where  $Z_{oo}$  is odd form of wave resistance and  $Z_{oe}$  is even form of wave resistance. Based on the physical parameters specified earlier, the formulas for determining the wave impedance are indicated below:

$$Z_{oo} = \frac{60 * \pi}{\left\{ \frac{W}{b} \right\} + \left\{ \frac{W}{S} \right\}} - C_o;$$

$$Z_{oe} * \sqrt{\epsilon} = \frac{60 * \pi}{\left\{ \frac{W}{b} \right\} + C_e}.$$

where:

$$C_e = 0.4413 - H;$$

$$C_o = H * \frac{b}{S};$$

$$H = \frac{\left(1 - \frac{S}{b}\right) * \ln\left(1 - \frac{S}{b}\right) + \left(\frac{S}{b}\right) * \ln\left(\frac{S}{b}\right)}{\pi * \left(1 - \frac{S}{b}\right)};$$

For calculations, were used the modern programming language Python version 3.6 with its built-in library of mathematical operations, as well as an additional module for the mathematical display of formulas to verify the correctness of the given formulas

### Conclusion

Thus, the article considers the basic mathematical calculations of a standard strip structure used for a wireless energy transmission system at a distance between metallic coatings of the order of 5 mm and the thickness of the dielectric substrates 5 mm. As a result of the calculations, the following values were obtained: wave impedances:  $Z_{0o} = 48.148 \text{ Ом}$ ,  $Z_{0e} = 107.920 \text{ Ом}$ ; power in used structure:  $P_2 = 0.55 \text{ W}$ . gain S21 turned out to be about  $-9 \text{ dB}$ . This value is not acceptable for a wireless power transmission system. In the future, research will be conducted using a variety of materials, as well as various types of structures.

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**Аннотация.** В статье представлена методика расчёта основных энергетических параметров электромагнитной структуры, используемой для построения системы беспроводной передачи энергии. Расчёт представлен по алгоритму, представленному в данной статье, численные вычисления реализованы в программной среде на языке программирования Python 3.6.

**Ключевые слова:** система беспроводной передачи энергии, подзарядка, расчёт.

**Annotation.** The article presents a methodology for calculating the basic energy parameters of the electromagnetic structure used to build a wireless energy transmission system. The calculation result is presented according to the algorithm presented in this article, numerical calculations are implemented in a software environment in the programming language Python 3.6.

**Keywords:** wireless power transmission system, charging, calculation.

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## **MICROWAVE METHODS FOR MEASURING DIELECTRIC PARAMETERS**

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### **1. Relevance of the problem**

The progress of modern electronics depends largely on the materials used. Therefore, new materials with certain characteristics are needed for further development of the industry. However, the creation of such materials is not possible without studying their physical properties. As a result, there is a need for precision methods for measuring the electrophysical parameters of materials, which is relevant not only for the electronics industry, but also for product quality control in various industries. One of the requirements for modern methods of studying the

electrophysical parameters of materials is the ability to conduct them contactless, without destroying the material and additional errors associated with contact phenomena. One of these measurement methods is microwave methods. Therefore, this article analyzes the existing microwave methods for studying the properties of materials, and also considers the criteria for choosing a specific measurement method based on the conditions and needs.

## **2. Main part**

Microwave methods for studying the characteristics of dielectrics can be divided into the following groups: feeder, resonator, and measurement of the parameters of dielectrics in free space.

“Feeder methods for measuring the dielectric parameters of a material consist in placing the test sample in a coaxial or waveguide transmission line, along which a microwave signal passes, after which the reflected signal is used to determine the reflection coefficient, transmission coefficient, or individual parameters such as phase shift, attenuation, etc.” [1, p. 69]. “Then the values of the dielectric and magnetic permeability of the sample are calculated. An example of this method is the use of a coaxial probe” [4, p. 2], which is a slice of the coaxial transmission line. The sample parameters are measured by dipping the probe into the liquid or touching the flat surface of the material with the probe. The structure of the fields at the end of such a probe is distorted as soon as they come into contact with the test material.

The main advantage of such measurement methods is the simplicity of implementation and manufacturing of the measuring cell, as well as the possibility of using standard equipment and measurement techniques. The disadvantage is that when the waveguide is filled with the material under study, there is almost always an air gap formed between the sample and the wide wall of the waveguide, which leads to a sharp jump in the electric field intensity during the transition from the sample material to the air and greatly affects the accuracy of determining parameters.

Resonator methods are more accurate methods for studying the electrophysical properties of materials. Using these methods, the test material is placed in a cavity resonator. From the shift of the eigenfrequency and the change in the quality factor of the resonator, the dielectric permittivity and the loss factor of the sample are determined by calculations. Methods using a cavity resonator can be divided into two subgroups. The first subgroup includes methods based on the excitation of the resonance directly in the measured sample, and the second-on the introduction of the sample perturbation in the field of the reference resonator. An example of a resonator group of methods can be the method

described in [2, p. 315-316], its essence consists in using proper polarization-degenerate  $HE$  - type oscillations in a resonator formed by the orthogonal intersection of cylindrical and radial beyond waveguides. The test sample is placed in a radial waveguide in the intersection area. When the proper  $HE_{11}$  oscillation is excited in such a resonator, the degeneracy is removed, and in the case of a homogeneous isotropic dielectric, a resonant oscillation occurs at a frequency that depends on the geometric dimensions and permittivity of the material. When studying an anisotropic dielectric in such a resonator, two proper orthogonal oscillations of the polarization plane occur, which are oriented in the directions of the highest and lowest values of the dielectric permittivity.

A feature of the group of resonator methods is a wide range of studied samples. The methods of the first subgroup are well suited for studying materials with a high dielectric permittivity value and low losses, and the methods of the second subgroup are suitable for materials with a low dielectric permittivity value and high losses. One of the disadvantages is that the methods are single-frequency, i.e. a set of resonators is needed to study the frequency dependencies.

Methods for measuring the parameters of dielectrics in free space assume the use of a measuring cell, the design of which includes two horn antennas and a holder of the material under study. A sample in free space is irradiated with an antenna and the reflection coefficient is measured. Using another antenna located on the opposite side of the sample, the transmission coefficient is measured. The calculation model of such a system is more complicated, however, the procedure for measuring and processing experimental data (transmission coefficient and reflection coefficient) does not differ significantly from the feeder method. Such measurement methods are widely used in microwave moisture, in particular in the determination of water content in petroleum products, one such method is described in [3, p. 1-4], the principle of operation of the device based on this method are the following: fluctuations in the microwave generator comes into the transmitting horn antenna, and then radiated electromagnetic wave passes through a controlled environment and arrives at the receiving antenna and detection section to measure the power passing through the medium wave, and progression phase, which is due to the presence of water in the environment. According to the assessment, the degree of signal absorption is roughly determined by the moisture content in the mixture, which makes it possible to determine the number of phase cycles of the microwave signal phase shift and thus determine the exact value of the phase shift and, accordingly, the percentage of water in the mixture. Measurement of the phase difference is performed at low frequencies obtained after the

homodyne frequency conversion of microwave signals, which allows for high measurement accuracy.

Certainly, the advantages of this method can be attributed to the fact that it is non-contact and can be applied to materials that must be studied at high temperatures and in aggressive environments. The measurement error is caused by refraction and diffraction phenomena, as well as the influence of external influences on the power of the electromagnetic wave when it is measured.

### **3. Conclusion**

The above review of microwave methods for measuring the characteristics of dielectrics showed that there are no universal methods due to the variety of material parameters. Each method has its advantages and disadvantages, and accordingly takes its place in the study of the properties of dielectric materials. However, the rapid development of technologies for creating electronic systems and components requires new, more advanced and accurate methods for measuring the electrophysical properties of materials. Certainly, resonator methods that have the highest accuracy in the study of dielectrics are promising. In addition, they can be adapted to study the properties of materials with different dielectric permittivity values and different loss levels.

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**Аннотация:** В рамках данной работы рассматривается проблема точного определения свойств и характеристик диэлектрических материалов. Рассмотрены основные СВЧ методы исследования обозначенной проблемы, на основе которых работают современные

измерительные приборы. Представлена классификация и дана краткая оценка преимуществ и недостатков этих методов. Приведены примеры измерительных и контролирующих устройств, в основе работы которых лежат СВЧ методы. На основании анализа существующих методов был сделан вывод о перспективных направлениях развития в данной области.

**Ключевые слова:** диэлектрик, методы измерений, СВЧ, коэффициент передачи, коэффициент отражения, сдвиг фазы, электрофизические свойства.

**Annotation:** In this work, we consider the problem of accurately determining the properties and characteristics of dielectric materials. The main microwave research methods of this problem, based on which modern measuring devices work, are considered. The classification is presented and a brief assessment of the advantages and disadvantages of these methods is given. Examples of measuring and monitoring devices based on microwave methods are given. Based on the analysis of existing methods, a conclusion was made about the promising directions of development in this area.

**Keywords:** dielectric, measurement methods, microwave, transmission coefficient, reflection coefficient, phase shift, electrophysical properties.

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## **PERIPHERAL KITCHEN CONTROLLER FOR SMART HOME SYSTEM**

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By “smart home” it is customary to understand a home automation system. This is a set of devices that for our convenience make their own decisions and do household chores [1].

The work of a smart home is based on the principle of executing commands, and their central controller can receive them both from a person and from sensors. In the first case, you ask the system to turn on the air conditioner or turn off the heating, and the central processor, after processing the command, sends it to the desired device. Depending on your preferences, communication with the central controller is carried out through voice commands, a remote control or a smartphone.

To build a Smart Home system, it is possible to use the MajorDoMo system [2] on the Orange Pi hardware platform as a server. For peripheral controllers you can use Arduino boards or boards based on AVR, STM or PIC microcontrollers of your own design.

The entire smart home system consists of three main elements:

- sensors that perceive information from the outside world;
- a hub or central controller that processes information and makes decisions;
- devices that perform applied tasks and make our life easier.

The aim of this work is to develop a peripheral controller for the kitchen of the Smart Home living space management system.

The block diagram, sensors and attached modules of the kitchen peripheral controller are shown in Fig. 1.

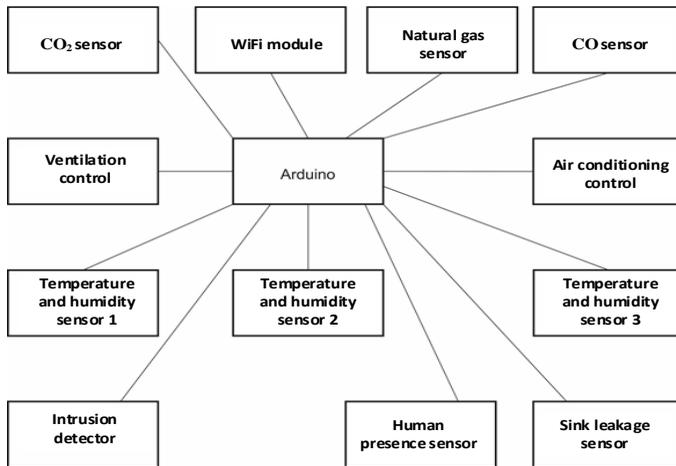


Figure 1 — Block diagram containing sensors and kitchen peripheral modules

Based on the analysis, the server is based on the Orange Pi Plus2E board [5]. This choice was made on the basis of its size, low cost,

versatility, support for various operating systems and its advantages compared to its predecessor Raspberry Pi.

Peripheral controllers, including the kitchen controller, are implemented on the Arduino Nano [6]. The platform is programmed using Arduino software. [3] It is possible not to use the bootloader and program the microcontroller through the outputs of the ICSP block (in-circuit programming).

“Arduino” was chosen as the basic element, which is distinguished by the simplicity of programming and has thanks to a clear interface. And has the following advantages:

- the ability to create your own programs, since the source code is open;
- a simple programming language;
- all the necessary programs can be transferred to the system using a usb cable.

Thus, the system can be most conveniently adjusted to the tasks being solved. Additional software for Arduino can always be obtained for free via the Internet. You can control the system as a regular PC, or using a smartphone after installing a special application.

Using wireless data transmission, sensors transmit commands and other information to a computer or smartphone. Through the program, the data is processed and the desired command is executed.

The kitchen peripheral controller controls two devices: a ventilation system and air conditioning. For control, information obtained from the following sensors is used:

- human presence sensor;
- natural gas leak sensor;
- carbon dioxide (CO<sub>2</sub>) sensor;
- carbon monoxide (CO) sensor;
- combined temperature and humidity sensors;
- sensor leakage washing.

In addition, the controller uses an unauthorized entry sensor.

To detect the opening of windows and doors in the burglar alarm, magnetic sensors are used. As a human presence sensor, we will use the module on the HC-SR501 infrared sensor [7]. The sensing element is 500BP pyroelectric sensor.

Natural gas leak sensor is MQ-4, and carbon monoxide sensor is MQ-7[8].

Both sensors belong to the class of electrochemical sensors. The electrochemical sensor is based on the principle of changing the resistance of a certain element when interacting with another element. In other words,

a chemical reaction occurs between these two elements, as a result of which the resistance of the substrate changes.

To determine the presence of carbon dioxide, an MH-Z19 sensor is used [9]. The MH-Z19 uses a non-dispersive infrared (NDIR) measurement method to detect the presence of CO<sub>2</sub> in air.

Combined temperature and humidity sensors AM2320 [4] in the amount of 3 pieces are located at remote points of the kitchen and are designed to determine the temperature and humidity in the room. Based on the data received from the sensors, the controller, using the principles of majority, controls the “warm floor” system and the ventilation system.

Leakage sensors B22 [10] is used to detect the fact of water leakage through unpressurized connections. The sensor has a sensitive sensor, from the area of which moisture has been analyzed. The device is also equipped with a comparator and has two outputs: analog and digital, for maximum ease of connection.

Thus, a peripheral kitchen controller has been developed for the Smart Home system, which allows controlling and controlling the temperature, controlling the ventilation system, monitoring water leakage, and determining the presence of a person in the room.

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**Аннотация.** Рассмотрены особенности построения системы Умный дом. В работе предлагается использовать плату Arduino Nano для создания периферийных контроллеров. Выбрана платформа для сервера. Разработан периферийный контроллер кухни, выбраны датчики периферийного контроллера. Контроллер позволяет осуществлять контроль и управление температурой, вентиляционной системой, протечкой воды, определять присутствие человека в помещении, определять несанкционированное проникновение в помещение. Для связи между сервером и периферийными контроллерами используется Wi-Fi, данные от датчиков в контроллер передаются в последовательном коде.

**Ключевые слова.** умный дом, Arduino, периферийный контроллер, датчики, контроль помещения

**Annotation.** The features of building a Smart Home system are considered. It is proposed to use the Arduino Nano board to create peripheral controllers. Selected platform for the server. A kitchen peripheral controller has been developed; peripheral controller sensors have been selected. The controller allows you to control and control the temperature, ventilation system, water leakage, to determine the presence of a person in the room, to determine unauthorized entry into the room. Wi-Fi is used for communication between the server and peripheral controllers, data from sensors to the controller is transmitted in a serial code.

**Keywords.** smart home, Arduino, peripheral controller, sensors, room control

## C-BAND BEAMFORMER INTEGRATED CIRCUIT DESIGN IN 180 NM SiGe BICMOS TECHNOLOGY

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### Introduction

Radio-frequency integrated circuits (RFICs) are widely used in phased array radar and communication systems. Civil applications of phased arrays are limited by complexity and high cost of such systems.

Application of beamformer integrated circuits (ICs) based on silicon (Si) or silicon-germanium (SiGe) technologies can solve the problem of phased array systems high cost, especially in mass production. They are gaining popularity among designers due to large-scale integration and cost effectiveness in comparison with GaAs, GaN, InP semiconductor technologies.

The challenge of accurate adjustment of the phase and attenuation states in phased arrays modules is extremely important for a number of civil applications. Temperature variation and yield greatly affects the performance of RFIC and system as a whole. Design of the complex beamformer RFICs for amplitude and phase control with built in temperature correction system based on Si or SiGe technologies can solve this problems [1].

Thus, the task of Si-based beamformer RFIC design that is not inferior in its characteristics to the best foreign analogues was set.

### Beamformer IC design

Complex RFICs design begins at the system level in terms of functional blocks set, their interconnection and chip interface.

Block diagram of the single-channel Tx/Rx beamformer IC is shown in Figure 1.

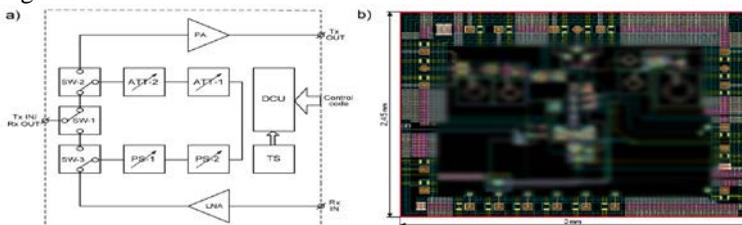


Figure 1 — Block diagram (a) and layout (b) of the designed beamformer IC

“Common leg” beamformer modules architecture is used in the designed RFIC. It consists of common for transmit (Tx) and receive (Rx) modes channel. As a result of that, it is extremely important to simulate precisely the isolation between receive and transmit channels in order to avoid circuits instability and additional gain and phase errors. Flexibility is an advantage of this architecture. It allows designer to connect external GaAs or GaN front-end modules in applications where high Tx power and low Rx noise figure are extremely important.

Main digitally controlled attenuator ATT-1 provides attenuation control in the range from 0 to  $-31$  dB with 1 dB step (5 bit resolution).

Main digitally controlled phase shifter PS-1 provides relative phase shifts of the output microwave signal in the range from 0 to 360 degrees with 5.625 degree step (6 bit resolution).

Switching between receive (Rx) and transmit (Tx) modes is held by single pole double throw integrated switches SW-1, SW-2, SW-3.

LNA and power amplifier (PA) compensate losses in Rx and Tx paths and provide additional amplification while processing the microwave signal. Additionally, three-stage diode limiter is implemented to protect Rx channel circuitry [2].

Integrated temperature sensor (TS) generates temperature-dependent voltage and converts it into digital codes. Based on these codes, digital control unit (DCU) changes states of additional corrective phase shifter PS-2 and attenuator ATT-2. DCU provides communication with an external control device (microcontroller) via a serial peripheral interface.

Layout of the beamformer IC is shown in Figure 1. Linear dimensions are  $2450 \times 3000$   $\mu\text{m}$ . Layout area —  $7.35$   $\text{mm}^2$ .

### **Simulation results**

The passive area of the chip, including all on-chip inductors, electrically long interconnections, is modeled using AXIEM planar EM simulator.

Complete RFIC post-layout simulation includes modeling of the IC packaging which consist of complex routing, advanced interconnect technologies and embedded passives.

The results of bond wires simulation are approximately in accordance to the rule of thumb: 1 nH of inductance for each millimeter of length of the bond wire. Nevertheless, 3D EM simulation results are more precise and more reliable. It is necessary to choose carefully the position of each of the bond wires because of interference from one bond wire to another due to electromagnetic induction.

The EM simulation results are taken into account by means of n-port components. They provide direct use of generated .s2p files or use other

different netlist files obtained from the .s2p files by means of a non-linear broadband conversion.

Post-layout simulation results of the designed RFIC are shown in Figures 2—5.

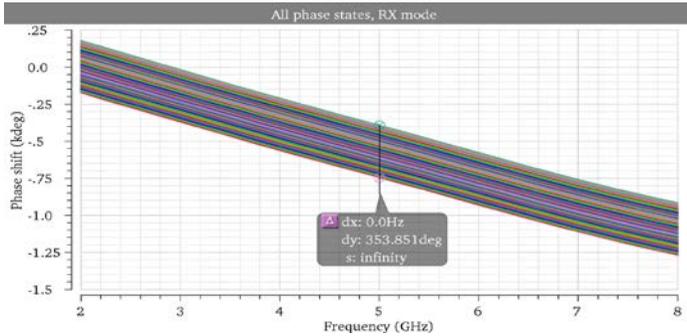


Figure 2 — Frequency dependence of the relative phase shifts from control code in Rx mode

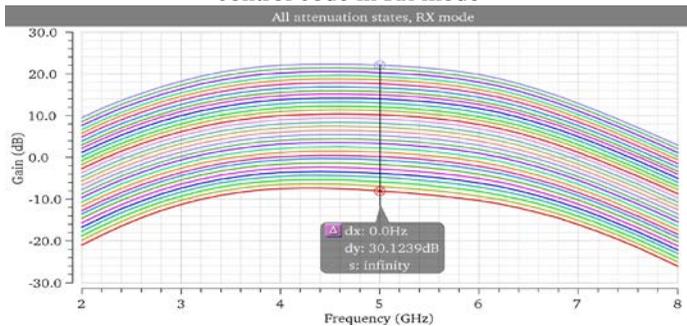


Figure 3 — Frequency dependence of the transfer ratio from the control code in Rx mode

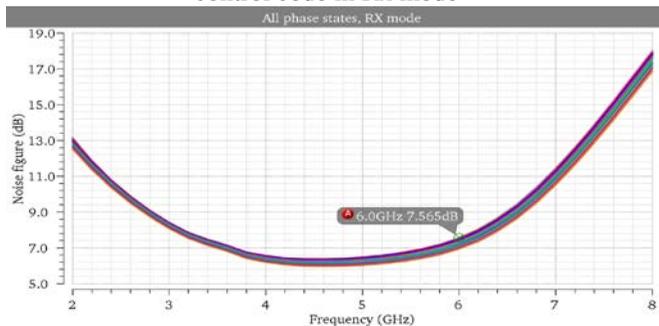


Figure 4 — Dependence of the noise figure in Rx mode from frequency

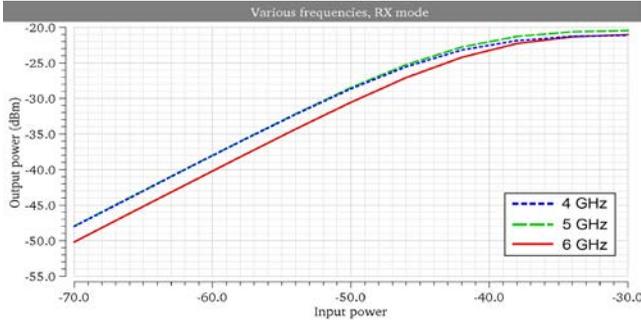


Figure 5 — Rx mode output 1 dB compression point simulation results

Based on post-layout simulation results calculated root mean square (rms) values of the attenuation and phase errors in Rx mode do not exceed 0.35 dB and 1.8 degrees respectively. Similar parameters for Tx mode do not exceed 0.5 dB and 2 degrees.

Noise figure of the RFIC in Rx mode is below 7.6 dB. Output 1 dB compression point in Rx mode is around  $-22$  dBm at a 5 GHz.

Parameters of the designed RFIC are shown in Table 1.

**Table 1.** Parameters of the designed beamformer IC

Parameter	Value, unit	Note
Operating frequency range	4—6 GHz	—
Operating temperature range	$-60$ — $85$ °C	—
Transfer ratio	22/35.5	Rx/Tx mode
Input and output return loss	$>10$ dB	
Isolation between Rx/Tx channels	$>50$ dB	
Attenuation range	31 dB	$f_{in} = 5$ GHz
Attenuation step	1 dB	
Attenuation error	$<0.5$ dB	rms value
Phase adjustment range	$360^\circ$	$f_{in} = 5$ GHz
Phase adjustment step	$5.625^\circ$	
Phase error	$<2^\circ$	rms value
Output 1 dB compression point	$-22$ dBm	Rx mode, $f_{in} = 5$ GHz

Parameter	Value, unit	Note
Noise figure	<7.6 dB	Rx mode
Channel switching time	<15 ns	—
Total power consumption	482/534 mW	Rx/Tx mode
Total layout area	7.35 mm <sup>2</sup>	with pads

### Conclusion

Beamformer RFIC design features are discussed in the paper. The design results of the C-band phased arrays Tx/Rx beamforming IC for sub-6 GHz communication systems design are presented. Precise post-layout simulation based on two-tool approach is implemented.

According to post-layout simulation rms attenuation and phase errors do not exceed 0.5 dB and 2 degrees. Noise figure in Rx mode according to the post-layout simulation results is below 7.6 dB. Output 1 dB compression point in Rx mode is -22 dBm. Power consumption in Tx/Rx modes does not exceed 534 mW and 482 mW. Total RFIC layout area is 7.35 mm<sup>2</sup>. Parameters correction system ensures stability of the RFIC characteristics in a wide range of operating temperatures.

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**Аннотация.** В статье представлены результаты моделирования приёмопередающей интегральной схемы (ИС) диаграммообразующих модулей фазированных решёток для систем связи диапазона до 6 ГГц. ИС разработана на основе 180 нм SiGe БиКМОП технологии. ИС формирования диаграммы направленности состоит из одного канала приёма/передачи с 6-разрядным фазовращателем и 5-разрядным аттенуатором с цифровым управлением. На основе цифрового интегрального датчика температуры реализована система коррекции амплитуды и фазы выходного сигнала. По результатам топологического моделирования среднеквадратическая погрешность

установки амплитуды и фазы не превышает 0,5 дБ и 2 градуса. Общая площадь топологии ИС не превышает 7,35 мм<sup>2</sup>.

**Ключевые слова:** БиКМОП, С-диапазон, фазированная решетка, SiGe, Core Chip, радиочастотная интегральная схема

**Annotation.** This paper presents simulation results of the C-band phased arrays transmit/receive (Tx/Rx) beamforming integrated circuit (IC) for sub-6 GHz communication systems. It is designed based on 180 nm SiGe BiCMOS technology. Beamformer IC consists of one Tx/Rx channel with digitally controlled 6-bit phase shifter and 5-bit active attenuator. Amplitude and phase correction system based on the integrated temperature sensor is implemented. According to post-layout simulation rms attenuation and phase errors do not exceed 0.5 dB and 2 degrees. Total IC layout area does not exceed 7.35 mm<sup>2</sup>.

**Keywords:** BiCMOS, C-band, phased array, SiGe, Core Chip, RFIC

**Благодарности:** Исследование выполнено при финансовой поддержке РФФИ в рамках научного проекта № 19-37-90128

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UDC 621.3.049.774

## RESEARCH OF THE BEAMFORMER INTEGRATED CIRCUITS FOR SUB-6 GHZ COMMUNICATION SYSTEMS

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### Introduction

Microwave spectrum below 6 GHz is increasingly used by a variety of radio systems and services with channels for transmitting enormous amount of data. The emergence of new systems and standards for wireless and satellite communications, navigation systems occurs in parallel with the improvement of semiconductor technologies and contributes to the rapid growth in the field of communications.

Orientation to the telecommunication equipment market for civil and special purposes is one of the key areas of the radio-electronic industry development. Fifth generation telecommunication networks (5G) are the next stage in the development of mobile technologies, involving a fundamentally new level of service and opportunities for customers. High average data transfer rate of about 1 Gbit/s, ultra-low information transfer delays of about 1 millisecond are the key features of the developing

standard. These advantages could solve many new problems that are connected with high demands on the reliability of the connection in real time.

Thus, more and more stringent requirements are imposed on modern electronic equipment of developing communication systems for speed, reliability, energy consumption while reducing overall dimensions and maintaining competitive cost.

Designing of a fundamentally new and improving of the existing electronic component base contributes to the satisfaction of these requirements.

### **Sub-6 GHz beamformer integrated circuits**

Active electronically scanned arrays (AESA), also known as phased array antennas, are widely used in the radars, radio navigation, and electronic warfare and communication systems. Extended detection ranges are attainable for AESA as compared to mechanically steerable antennas. Phased array antennas consist of multiple stationary elements, which are fed coherently. Variable phase or time delay at each element is used to scan the beam at given angles in space. AESA systems are more reliable than their mechanical counterparts and provide reduced maintenance efforts.

Currently, beamformer modules, which are built primarily on the basis of high-cost gallium arsenide (GaAs) microwave monolithic integrated circuits (MMICs), are widely represented. The world leaders in the production of these types of integrated circuits are MACOM, OMMIC, Astra Microwave Products Ltd., UMS, METDA Technology Co.

Russian companies such as JSC “RPC “Istok”, SPC “Micran”, JSC “NIIPP” produce integrated circuits for designing AESA beamformers mainly for defense industry.

Selection of the Si-based technologies could solve the integration problem of beamformer IC analog and digital part and reduce its fabrication cost. Moreover, SiGe devices provide better dynamic characteristics than analogues, which are developed on the basis of standard CMOS processes [1].

The leader in the production of Si-based mm-wave beamformers for advanced 5G communication systems, satellite communications systems and commercial radars is Anokiwave fabless semiconductor company. Design of separate Si-based ICs functional blocks such as microwave switches, low noise and power amplifiers, phase shifters and attenuators in PJSC “Micron”, JSC “Progress MRI”, JSC “NIIPP”. Thus, Si and SiGe complex multifunctional MMICs for signals amplitude and phase control in AESA systems are not yet widely represented on the domestic market.

In this regard, the task of the research of the commercially available beamformer integrated circuits (ICs) for sub-6 GHz communication systems was set.

Korean company RFCore produces phase and amplitude control ICs for phased arrays based on 130 nm CMOS technology. Product line includes S-, C-, X-band beamformers [2].

Figure 1 shows block diagram and chip photograph of the S-band RMF020040DA beamformer IC.

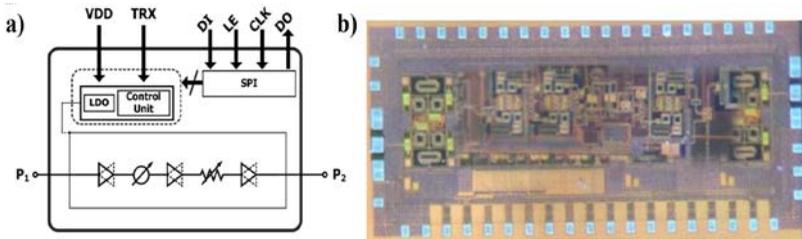


Figure 1 — Block diagram (a) and chip photograph (b) of the RFCore RMF020040DA

Single channel beamformer IC provides 8 dB transfer ratio in 2—4 GHz frequency range with 6-bit phase and attenuation control. It includes bi-directional gain blocks, fully integrated low dropout regulator (LDO) and bias circuits with bandgap reference. IC digital control block provides communication with an external control device via a serial peripheral interface (SPI). A feature of the chip is 3-bit amplitude tuning circuits.

RFCore RMF040080DA ensures the same parameters as RMF020040DA but in 4—8 GHz frequency range. IC photograph is presented in Figure 2. Linear dimensions of the chip are  $3 \times 1.3$  mm.

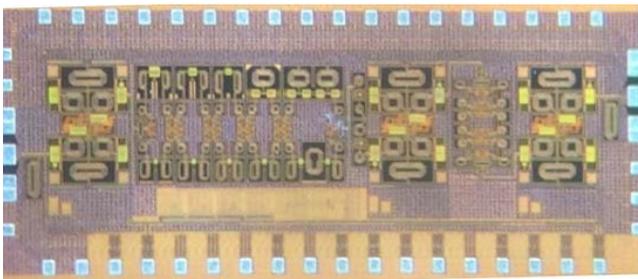


Figure 2 — Chip photograph of the RFCore RMF040080DA

The latest development of the RFCore is the RMF053055PA2CH 2 channels C-band multifunctional chip which works in the frequency range from 5.3 to 5.5 GHz (see Figure 3).

Each channel includes 6-bit phase shifter, 6-bit attenuator, 4-bit tuning circuits, gain blocks, LDO, SPI, and external devices bias controller with  $-5 \dots -1$  V control voltage range.

It covers phase shifting range  $360^\circ$  with  $5.625^\circ$  step, and attenuation range 31.5 dB with 0.5 dB step. QFN package size is  $6.5 \times 4.5 \times 1$  mm with 46 leads. Chip is fabricated in CMOS process.

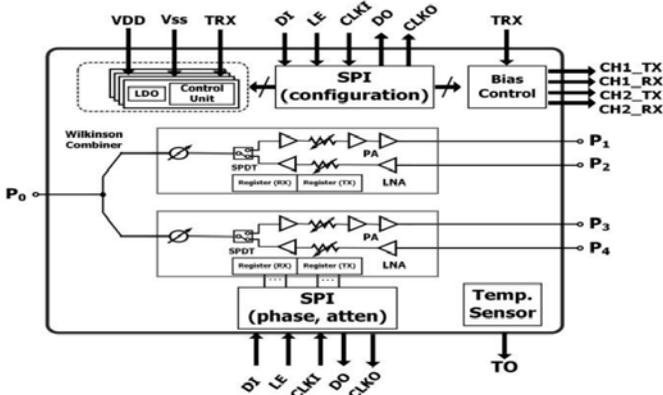


Figure 3 — Block diagram of the RMF053055PA2CH beamformer IC

All functions are controlled by internal registers through two separated serial interfaces. An additional feature of the chip is parameters correction possibility based on the integrated temperature sensor data.

French company OMMIC is a pioneer and a leader in the III-V domain, in particular in GaN and GaAs semiconductor technologies. With the release of its new 6-inch production line, OMMIC has positioned itself as industrial leader in the development of the European telecommunications.

They are supplying CGY2175AUH/C1 beamformer IC [3]. It is a high performance 3 port, 6-bit Core Chip operating in C-band. It includes a 6-bit phase shifter, a 6-bit attenuator and transmit/receive (Tx/Rx) switch. The serial to parallel converter minimizes the number of bonding pads and greatly simplifies the use of the chip functions.

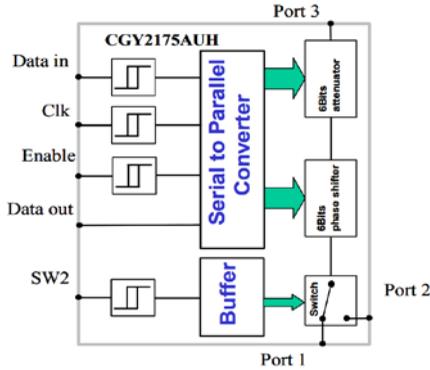


Figure 4 — Block diagram of the CGY2175AUH/C1 beamformer IC

Tx/Rx switching time is about 10 ns. QFN package linear dimensions are 7×7 mm with 44 leads.

The chip is manufactured using OMMIC’s 0.18 μm gate length PHEMT Technology. This technology has been evaluated for Space applications and is on the European Preferred Parts List of the European Space Agency.

MACOM Company designs and manufactures semiconductor products for data centers, telecommunication systems, industrial and defense applications. MACOM XZ1001-BD beamformer IC is shown in Figure 5.

The XZ1001-BD is a highly integrated transmit/receive 4 ports Core Chip. It is designed for applications operating within the 2.5 to 4 GHz range [4]. “Common leg” beamformer modules architecture is used in the MMIC.

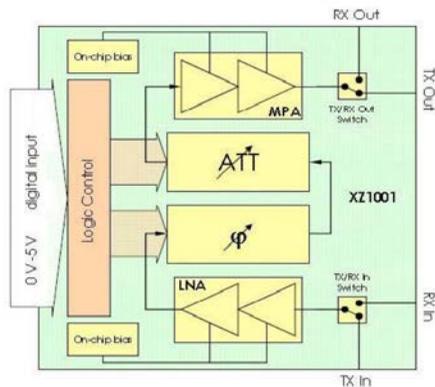


Figure 5 — Block diagram of the XZ1001-BD beamformer IC

The MMIC consists of integrated transmit/receive switches, low noise amplifier (LNA), 6-bit phase shifter, 6-bit attenuator and driver amplifier. The digital control logic allows fast phase shifter and attenuator changes. The chip has surface passivation to protect and provide a rugged part with backside via holes and gold metallization to allow either a conductive epoxy or eutectic solder die attach process.

Parameters of the beamformer MMICs are shown in Table 1.

**Table 1.** Parameters of the beamformer ICs

	<b>RMF02 0040DA</b>	<b>CGY2175B UH/C1</b>	<b>RMF04 0080DA</b>	<b>RMF05305 5PA2CH</b>	<b>XZ1001 -BD</b>
<b>Frequency range, GHz</b>	2—4	4.5—6.5	4—8	5.3—5.5	2.5—4
<b>Number of channels</b>	1			2	1
<b>Transfer ratio, dB</b>	8	-12	8	15/5	33
<b>Input/output Return loss, dB</b>	10	15	10		
<b>PS resolution, bit</b>	6				
<b>PS step, °</b>	5.625				
<b>RMS phase error, °</b>	—	2	—	1	1.5
<b>ATT resolution, bit</b>	6				
<b>ATT step, dB</b>	0.5				
<b>RMS attenuation error, dB</b>	—	0.5	—	0.3	0.7
<b>OP1dB (Tx mode), dBm</b>	0	20	0	24	20
<b>Noise figure (Rx mode), dB</b>	—			4.8	2.5
<b>Supply voltage, V</b>	—	-3.25—5.5	—		8
<b>Power consumption, mW</b>	75	100	75	—	5400
<b>Chip area, mm<sup>2</sup></b>	3.9	17.94	3.9	—	29.8
<b>Technology</b>	130 nm CMOS	0.18 $\mu$ m GaAs pHEMT	130 nm CMOS	CMOS	GaAs pHEMT

## Conclusion

Research of the sub-6 GHz beamformer MMICs current state allows us to draw the following conclusions:

- AESA beamformer modules integrated circuits are available for various applications with relatively narrow operating frequency bands (from 0.5 to 4 GHz) in S- and C-bands;
- GaAs pHEMT ICs offer higher output 1 dB compression point and lower noise figure;
- Si-based beamformer modules occupy less chip area and provide large-scale integration;
- Resolution of integrated phase shifters and attenuators for most ICs is equal to 6 bit;
- Phase shifter control range for most ICs is equal 360 degrees;
- Attenuation control range for most ICs is equal 31 dB;
- ICs contains an integrated digital control unit and temperature sensor for MMIC parameters correction as the additional feature.

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**Аннотация.** В статье представлены результаты обзора серийно выпускаемых интегральных микросхем (ИМС) диаграммообразующих модулей активных фазированных антенных решёток (АФАР) диапазона частот до 6 ГГц. Обсуждаются особенности построения схем, вопросы разработки и применения систем коррекции параметров ИМС. Исследованы современное состояние технологий и перспективы развития электронной компонентной базы ИМС управления амплитудой и фазой сигнала.

**Ключевые слова:** МИС, АФАР, диаграммообразующий модуль, многофункциональная схема, управление амплитудой и фазой, фазовращатель, аттенуатор

**Благодарности:** Исследование выполнено при финансовой поддержке РФФИ в рамках научного проекта № 19-37-90128

**Annotation.** The results of a review of commercially available beamformer integrated circuits (ICs) for sub-6 GHz active electronically scanned arrays (AESA) are presented in the paper. Circuits building features and issues of design and application of IC parameters correction systems are discussed. The current state of technologies and perspectives for development of the signals phase and amplitude control ICs electronic component base are studied.

**Keywords:** MMIC, AESA, beamformer module, multifunctional circuit, amplitude and phase control, phase shifter, attenuator

**Acknowledgments:** The reported study was funded by RFBR, project number 19-37-90128

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## **RADIATION CHARACTERISTICS OF ARRAY OF KHARCHENKO ANTENNA ELEMENTS**

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In the early 60s of the last century Kharchenko K.P. the simple flat antenna with good performance was proposed. Author's certificate No. 138277 for an invention entitled "Band Directional Antenna" K.P. Kharchenko issued in 1961. In the same year, materials were published in the journal Radio [1].

The Kharchenko antenna is a special case of a zigzag antenna; it has been widely used as a receiving television antenna [2] and is used in data transmission systems using Wi-Fi [3]. The antenna can also be used in radio frequency identification systems [4].

However, theoretically, the Kharchenko antenna is poorly understood. The aim of the work is to study ways to increase the gain of the Kharchenko antenna.

A simple square-frame element located in the horizontal plane is characterized by a gain of 1 dBd. An antenna with two such elements in the horizontal plane with a common precise excitation has a gain of 4 dBd. Thus, a bi-directional emitter is obtained, the width of the radiation pattern of which is smaller in the direction of displacement of the frame elements [5].

In [6], an electrodynamic analysis of the Kharchenko antenna from two frames was performed. However, the Kharchenko antenna made of four frames and the Kharchenko antenna with a reflecting surface and the array of Kharchenko antennas are of practical interest. All these options make it possible to reduce the width of the radiation pattern of the antenna system, and therefore, to obtain an antenna with a large gain, which will improve the energy characteristics of the data transmission system.

Fig. 1 shows a volumetric radiation pattern of the Kharchenko antenna with four frames, a) is a volume radiation pattern, b) is a vertical section of a radiation pattern. The edge length of the square is a quarter of the wavelength.

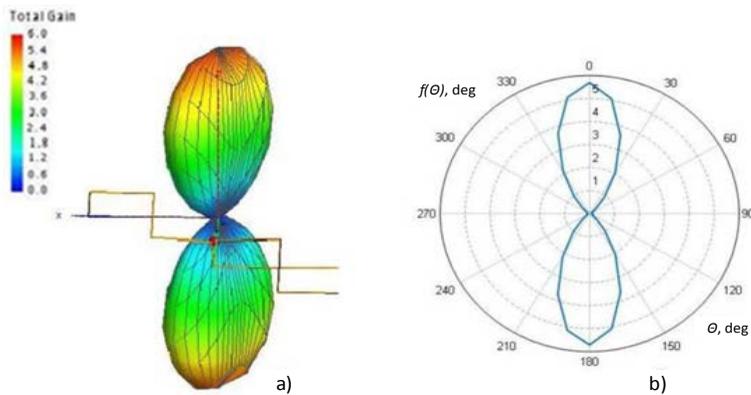


Fig. 1 — Patterns of Kharchenko antenna with four frames

The study was performed using numerical analysis tools. Antenna analysis was performed in the frequency range 900 - 1200 MHz.

The width of the beam pattern of the Kharchenko antenna with four frames at half power level is about 30 percent less than the width of the antenna pattern with two frames.

Fig. 2 shows a three-dimensional radiation pattern of an antenna array of two Kharchenko antenna elements with four frames, a) — a three-dimensional radiation pattern, b) — a vertical section of a radiation pattern.

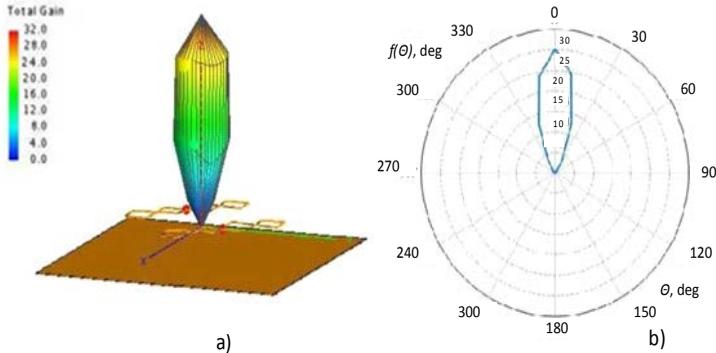


Рис. 2 — The pattern of the two-element array with Kharchenko antenna elements with four frames

The metal screen is located  $1/4$  of the wavelength from the grating. To eliminate intersections of wire elements, part of the edges of the frames are vertically offset by 5 mm.

The antenna forms a linearly polarized radiation field.

Figure 2 shows that the use of the array and two antenna elements of Kharchenko and the use of a screen to form unidirectional radiation can significantly reduce the width of the radiation pattern of the antenna system gain.

Thus, an antenna array based on the Kharchenko antenna with four frames with a reflective screen has been developed, which has an increased value of the gain, which can be used in television systems as a receiving antenna, in data transmission systems using WiFi and radio frequency identification systems.

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**Аннотация.** Рассмотрены особенности построения антенной системы на базе антенны Харченко с четырьмя рамками. В работе предлагается использовать синфазную малоэлементную антенную решетку с отражающим экраном и антенными элементами Харченко для увеличения коэффициента усиления антенной системы. Выполнен анализ характеристик излучения предложенной антенной системы с помощью программы численного анализа. Антенная решетка на базе антенны Харченко является простой и технологичной, может быть использована в системах телевидения в качестве приемной антенны, системах, использующих Wi-Fi и системах радиочастотной идентификации.

**Ключевые слова.** антенна Харченко, антенная решетка, зигзагообразная антенна, вибраторная решетка, вибраторные ряды

**Annotation.** Features of building an antenna system based on the Kharchenko antenna with four frames are considered. It is proposed to use a common-mode low-element antenna array with a reflective screen and Kharchenko antenna elements to increase the gain of the antenna system. An analysis is made of the radiation characteristics of the proposed antenna system using a numerical analysis program. The antenna array based on the Kharchenko antenna is simple and technologically advanced; it can be used in television systems as a receiving antenna, systems using Wi-Fi and radio frequency identification systems.

**Keywords.** Kharchenko antenna, antenna array, zigzag antenna, vibrator array, vibrator rows.

## SHIP AUTOMATION AND CONTROL SYSTEMS

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**Introduction.** Dictionary says “Automation or automatic control” is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications with minimal or reduced human intervention. Some processes have been completely automated.

Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ships typically use all these combined techniques. This is especially true for shipbuilding and its production processes.

**The main part.** Shipbuilding has always been based on new technologies. In recent years, the development of ships has been based on the introduction of new solutions to traditional shipbuilding disciplines - hydro-mechanics, strength of materials and energy. A little later, the main priority was given to the application of physical fields (acoustic, electromagnetic, radar, thermal, radiation, etc.). significant results were achieved in all of the above sectors [1].

The development of shipbuilding over the past 20 years has been characterized by the degree of use of electronic systems. In a historically short period, shipbuilders have gone from automated ship rudders and some automated weapons on warships to complex systems for automatic control of power plants, equipment, and ship movement. A fully integrated control system is currently being developed. Modern automated ship control systems have a high degree of reliability, high survival rate, large volume and high speed of signal processing.

The new tasks and principles allow formulating the new general requirements to the perspective ships. The most important of them are as follows [2, p. 76].

- multi role nature of a ship in general;
- universal nature of electronic systems;

- high survival rate;
- maximum compatibility with foreign ships and possibility of cooperating;
- maximum level of ecological safety;
- improved living conditions;
- highly ergonomic machinery.

The multi role nature of large ships as well as the complicated nature of their operations excludes the suggestion to make the ships fully automatic even in the remote future. Therefore the development of ship automation should be based on further integrating separate functional systems, extending their intellectual level and the number of the instruments that can be used. The most perspective direction of automating the ship and introducing robots is ensuring the viability during various damages, as well as servicing potentially dangerous units and systems.

Modern shipbuilders have practically completed changing over to the use of the most modern electronic components and hardware. This enables to assess prospects and philosophies for configuring complex control systems for engineering systems (CCS ES) of the XXI century. The new-generation systems, which should become intellectual, will be designed based on the following principles.

- integration of CCS ES subsystems based on a common (uniform) set of components;
- increase of the share of warning or prediction control actions in addition to the existing damage-response control actions;
- development of computer-aided safety systems;
- increase of the automation level;
- introduction of distributed network architecture based on a common telecommunication net with enhanced reliability and survivability features;
- transition from the concept of operator and technical control station to the philosophy of management-and-engineering systems;
- connection to an integrated information space of the ship;
- establishment of CALS (Computer-Aided Acquisition and Logistics Support) technologies for the development of our products and for supervising them through all stages of their service lives.

On a ship there are many parameters that needs to be controlled or monitored including: temperatures, pressure, level, viscosity, flow control, position of vessel, speed, torque control, voltage, current, machinery status (on/ off), and equipment status (open/ closed).

“As the market is driving ship owners to become more efficient with reduced staff on board it called for an automatic control and monitoring system for the ship that enabled unattended operation of machinery spaces.

Vessels capable of safe operation at any period of time qualify as UMS (Unattended Machinery Space) ships” [3 p. 34].

A modern automation and control system is a fully integrated systems covering many aspects of the ship operation that includes the propulsion plant operation, power management operation on the auxiliary engines, auxiliary machinery operation, cargo on-and-off-loading operation, navigation and administration of maintenance and purchasing of spares.

Propulsion (Main Engine) and Power (AuxiliaryEngines) Monitoring and Control.

Monitoring and control of the ships propulsion and power is essential for its efficiency and safety and there are many systems and parameters to consider like: fuel consumption, combustion temperature, engine temperature, diesel engine safety and start/stop, generator voltage and frequency control, generator load in KW and %, load control, torque, heavy consumers logic, control of diesel electric propulsion, thrusters monitoring and control etc.

Auxiliary Machinery Monitoring and Control.

Control and monitoring of auxiliary equipment covers several systems, such as: main sea and fresh water cooling system – pumps, system pressure, temperature. etc., drinking and fresh water Control, air compressors, hold and sludge control-tank level, pumps, fuel oil system-tank level, temperature., viscosity, flow, purifiers, heaters, etc., Other cooling systems, boiler / steam system-pumps, valves, pressure temperature. etc., air Conditioning, ballast water treatment, exhaust gas treatment equipment.

Cargo and Ballast Monitoring and Control.

For the safe loading and unloading of cargo, especially on tankers, this process is carefully monitored and many times includes functions such as level measurement, cargo pump control, valve control, ballast and ballast pump control, roll control, remote monitoring of temperature, pressure and flow.

Condition Based Monitoring.

In order to further improve ship performance, many equipment manufacturers are considering including ship condition monitoring capabilities in the main management and monitoring system. This would further increase the ability to prevent breakdowns on Board.

The inter-repair life of automated equipment should be at least 25 thousand hours, and the annual operating time of the equipment without adjustments should be at least 5 thousand hours.

Automation elements and devices must work reliably with a long roll of the vessel up to 22.5° and a long trim up to 10°, as well as with a side roll up to 45 ° with periods of 5-17 seconds.

All automation equipment is designed or selected based on the principle of "failure in safe side".

On modern automated vessels, the total number of so-called "peripheral automation" devices reaches 500-700 units. Operational practice shows that this equipment is the least reliable. Numerous sensors and alarms have resource characteristics 2-2.5 times lower than the guaranteed resource of complex automation systems themselves. The reliability characteristics of complex automation systems delivered to the fleet are guaranteed by the developers without taking into account the sensors included in the systems. With a guaranteed technical resource of the automated complex equal to 25 thousand rubles up to 75 % of the sensors included in it have a technical resource of 5-10 thousand hours and an actual operating time of no more than 2-3 thousand hours.

The primary tasks at the current stage of automation development are: improving the reliability of the element base; organizing maintenance of automation systems in ship conditions and in the port; training personnel who are able to technically correctly operate automation systems and perform the necessary preventive measures [4].

The ship automation system is approved by major classification societies for marine installations. A modular architecture enables efficient process handling. The system is capable of handling huge amounts of data at high speed. Alarm handling is of vital importance, but the system also monitors and controls various on-board sub-processes. Extension modules like fully integrated PMS and HMS systems are available.

### **Conclusion.**

Within the environment of a marine plant there are many parameters which need to be controlled or monitored including: temperatures, pressure, level, viscosity, flow control, speed, torque control, voltage, current, machinery status (on/ off), and equipment status (open/ closed). The field of automation and control system is vast; there are many different ways of achieving the required effects by the operator of marine systems. It is impossible to cover all the aspects of the control used in ship. This article tried to give you an overview of automatic controls used in ships.

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**Аннотация:** В статье прослеживается история развития новых технологий в судостроительстве. Внимание уделяется полностью интегрированной системе контроля, которая включает управление и контроль гребной установки (главный двигатель) и силовую установку (вспомогательные двигатели), управление и контроль вспомогательных механизмов, груза. В статье перечисляются задачи и принципы, которые являются основой новых основных требований в судостроении. В настоящее время известен такой наращиваемый модуль как АСУЭ (система управления энергосистемой).

**Ключевые слова:** судостроение, полностью интегрированная система контроля, новые технологии, высокая степень надежности, современная система управления и автоматизации.

**Annotation:** The article traces the history of the development of new technologies in shipbuilding. Attention is focused on the development of a fully integrated control system which includes: Propulsion (Main Engine) and Power (Auxiliary Engines) Monitoring and Control, Auxiliary Machinery Monitoring and Control, Cargo and Ballast Monitoring and Control. The article lists new tasks and principles that form the basis of new General requirements for shipbuilding. Nowadays extension module like fully integrated PMS system is available.

**Key words:** shipbuilding, fully integrated control system, new technologies, high degree of reliability, modern automation and control system.

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## **THE RESEARCH OF THE ANTENNA ARRAY, BASED ON INDIVIDUAL SLOT OSCILLATOR**

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### **Introduction**

This article will discuss the problem of Tapered Slot Antenna, an expanding slot antenna for radio monitoring systems. This type of antenna is currently promising, due to the emergence of electromagnetic CAD (due to exponentially expanding slot this kind of antenna is rather difficult for mathematical calculation).

Vivaldi's antennas work in the frequency range from 0.3 to 17 GHz that carries them to ultrabroadband.

It is necessary to examine this antenna for further use in antenna arrays. The initial data for antenna modeling and calculation are:

- Stable operation in frequency band 3 - 6 GHz;
- SWR <2;

It is also necessary:

- Select dielectric substrate material;
- Match the transition from strip power line to slot power line.
- Consider mathematical principles of antenna array construction.

### **Materials and methods**

The slotted emitter being developed is considered to be part of an antenna array, where the overall gain (and directivity pattern) is a summation of the radiation range of each emitter, so consider for starters the general principles of antenna array formation.

Single slot radiators will subsequently form a flat antenna array. The flat design allows for relatively easy creation of antenna arrays from TSA both linear (simply repeating multiple TSA on one wide board one after the other) and volumetric (on a cell principle) with two linear or one rotating polarization.

Antenna arrays allow to increase frequency band, as well as to achieve suitable radiation form due to variability of number and shape of radiators, as well as their location on radiating surface.

Typically, Vivaldi radiators in the implemented phased array are positioned equidistantly in the nodes of a rectangular or triangular grid. A triangular coordinate grid is more preferred because it provides a larger allowable distance between elements, which reduces their total number. The **directional pattern** for the antenna array, which consists of identical radiators, is as follows:

$$F(\theta, \varphi) = f(\theta, \varphi) \cdot f_E(\theta, \varphi).$$

Where  $f(\theta, \varphi)$  — is the chart of the isolated radiator,  $f_E(\theta, \varphi)$  — is the multiplier of an antenna lattice determined by a formula:

$$f_e(\theta, \varphi) = \sum_{m,n=1}^{MN} A_{mn} \cdot \exp [i(\Phi_{mn} + \Phi_{mn}^s)] .$$

Where  $A_{mn}$  — is an amplitude of excitation of an antenna lattice,  $\Phi_{mn}^s = k(x_{mn} \cdot \cos(\varphi) + y_{mn} \cdot \sin(\varphi)) \cdot \sin(\theta)$  — spatial phase shift for the direction of observation ( $\theta, \varphi$ ).

Flat antenna arrays in which Vivaldi antennas are arranged in parallel rows have become most common. Figure 1 shows a fragment of such a grid consisting of nine elements, the area of which is  $S$ , with a view on the side of the ends of the elements (on the side of radiation (reception)), indicating the corresponding distances between the "rows" and "columns" of the elements.

As shown in Figure 1, AP elements are located in the nodes of a rectangular grid. For expansion of bandwidth it is necessary to increase the maximum wavelength of  $\lambda_{max}$  and to reduce the minimum wavelength of  $\lambda_{min}$  accepted by an antenna lattice. Therefore, in order to extend the bandwidth, it is necessary to increase the size  $W$ , which cannot be greater than the array pitch  $dy$  (as shown in Figure 1). The desire to increase the grid pitch  $d$  results in diffraction maxima.

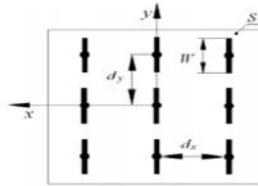


Fig. 1 — Arrangement of radiators in antenna array in corners of rectangular grid

Conditions of occurrence of diffraction maxima for antenna array with arrangement of elements along rectangular grid are recorded as follows:

$$\frac{dx}{\lambda} \leq \frac{1}{(\sin(\theta_{zmax}) + 1)} ;$$

$$\frac{dy}{\lambda} \leq \frac{1}{(\sin(\theta_{ymax}) + 1)} .$$

Where:  $\theta_{zmax}$  and  $\theta_{ymax}$  — maximum beam deflection angles in XOZ and ZOY planes.

The diffraction maxima of the antenna grating pattern occur when the wavelength becomes smaller than the antenna grating pitch, as can be seen from the formula for  $\theta_{ymax} = \theta_{zmax} = 0^\circ$ .

If  $\theta_{ymax} = \theta_{zmax} = 90^\circ$ , that  $\frac{d}{\lambda} \leq 0.5$ .

Thus, in the top part of range the strip of operating frequencies of an antenna lattice is limited to its step  $\lambda_{min} = d$ , and in the lower part — width of the antenna of Vivaldi of  $\lambda_{max} = 2W$ .

It follows from the comparison that the maximum pitch of the antenna array elements in the nodes of the triangular grid is 1.15 times the pitch of the antenna array elements in the nodes of the rectangular grid.

Since this slot antenna should operate in the frequency band 3 — 6 GHz, we calculate its geometric dimensions of the opening.

Maximum ( $W_{max}$ ) and minimum ( $W_{min}$ ) size of antenna opening is calculated by formulas:

$$W_{max} = \frac{c}{2 \cdot f_{max} \cdot \sqrt{\epsilon_r}};$$

$$W_{min} = \frac{c}{2 \cdot f_{min} \cdot \sqrt{\epsilon_r}};$$

Where:  $c$  — speed of electromagnetic wave propagation in vacuum  $f_{max}$  и  $f_{min}$  — maximum and minimum operating frequency,  $\epsilon_r$  — dielectric constant of antenna substrate.

Set the initial value of the dielectric by assuming the use of an organic-ceramic laminate having a dielectric constant of  $\epsilon_r = 4,7$ .

Let's substitute numerical expressions in formulas (1) and (2) and we will receive that maximum having opened  $W_{max} = 3.2$  cm antennas, and minimally  $W_{min} = 1.1$  cm.

Figure 2 is a schematic representation of a single emitter for further simulation.

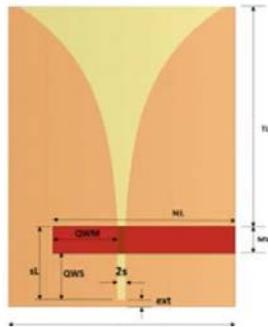


Fig. 2 — Geometrical sizes of the antenna

## Results

Model dielectric substrate is made on Taconic family RF-60A material. RF-60A is an organic ceramic laminate from the Taconic ORCER family of products. It is based on reinforcement with woven glass. RF60A shows

exceptional interlayer bond strength and soldering resistance. The patented RF-60A composition provides low moisture absorption and uniform electrical properties. The dielectric constant is RF-60A 6.15 and the dielectric loss tangent is 0.035.

The model in *CST MICROWAVE STUDIO* is shown in Figure 3(a) — top view and Figure 3(b) — bottom view.

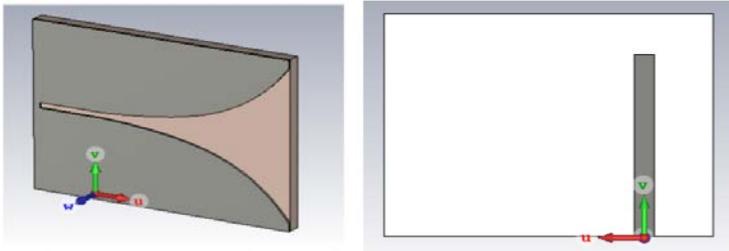


Fig. 3 — Vivaldi emitter (a) — top view, (b) — bottom view

In figure 3(b) is seen that the supply line is a symmetrical microstrip line. Important is the question of matching of the microbeam and slot part of the antenna.

Enter all antenna material parameters into the TXline program to determine the transmitter width. From Figure 4 it can be seen that the strip line has a wave resistance of 50 ohms at a width of 3.718 mm.

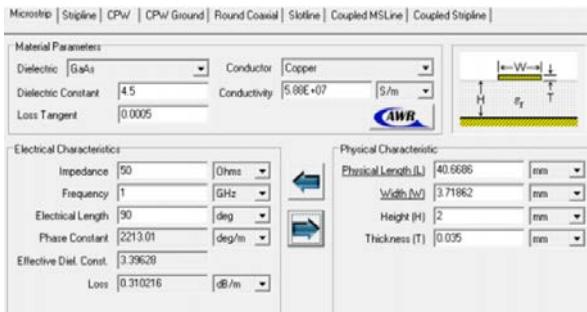


Fig. 4 — Calculation of width of the transformer

The antenna direction can be estimated from the diagrams shown in Figure 5.

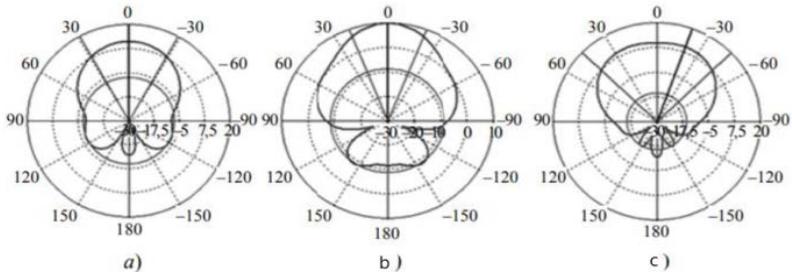


Fig. 5 — Vivaldi emitter directivity pattern at different frequencies (a - 3 GHz, b - 5 GHz, c - 6 GHz)

SWR values are shown in Figure 6.

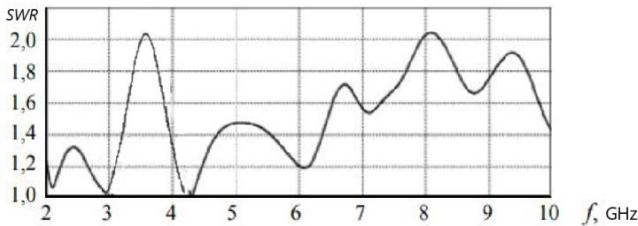


Fig. 6 — SWR value of the oscillator

As we can see, the antenna is perfectly aligned in the operating frequency band.

### Discussion and Conclusions

The presented results allow to draw the following conclusions: use of the antennas of Vivaldi located in antenna array with a triangular grid with  $dx$  step =  $1.2\lambda_{min}$  increases a broadbandness of antenna array to two times in comparison with their arrangement on a rectangular grid.

The simulated antenna is the single radiator executed on a dielectric substrate ( $\epsilon_r = 4.7$ ) from organiko-ceramic laminate.

Overall dimensions of antenna are made in accordance with assigned frequency band (3 - 6 GHz). This antenna is consistent in this frequency band ( $SWR < 2$ ).

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**Аннотация.** Стремительное развитие современной радиосвязи и радиолокации повсеместно повышают интерес к более эргономичным антенным системам. К антенным устройствам предъявляется ряд новых требований. Они должны быть более тонкими, легкими, дешевыми, а под эти требования больше всего попадают печатные антенны (микрополосковые). В данной работе исследуется антенна Вивальди с экспоненциально расширяющейся щелью в целях дальнейшего применения в составе антенных решеток, применяемых в комплексах радиомониторинга.

**Ключевые слова:** радиомониторинг, целевые антенны, антенна Вивальди, антенные решетки, малогабаритность.

**Annotation.** The rapid development of modern radio communication and radar everywhere increases interest in more ergonomic antenna systems. Antenna devices have a number of new requirements. They should be thinner, lighter, cheaper, and printed antennas (microstrips) fall most under these requirements. This paper explores the Vivaldi antenna with exponentially expanding slot for further use in antenna arrays used in radio monitoring complexes.

**Keywords:** radio monitoring, slot antennas, Vivaldi antenna, antenna arrays, small size.

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## MEASUREMENT OF THE STRIP LINE DIELECTRIC PARAMETERS

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## 1. Introduction

Currently, the measurement of electrical characteristics of dielectrics in the VHF range is carried out mainly by resonant methods, which involve the production of samples of a special shape and strictly defined sizes. One of the problems is the need to measure the parameters of dielectric materials of strip line substrates in the microwave frequency range.

## 2. Main part

An asymmetrical strip line is a conductor of rectangular cross section located above the grounded plate, which is the second conductor of the line. The line conductors are separated, as a rule, by a layer of solid dielectric – the base, and the line is called in this case microstrip. The dielectric between the upper screen and the strip conductor is usually air.

The wave resistance of an asymmetric strip line with a quasi T wave is the ratio of the voltage between the internal (strip) conductor and the grounded plate to the current in the strip conductor in the traveling wave mode in the line. The wave resistance  $\rho$  in ohms of the line with dielectric filling is determined by the relation [1]:

$$\rho = \frac{\rho_1}{\sqrt{\epsilon_{eff}}}$$

Where  $\rho_1$  — is the wave resistance of a line with the same dimensions and arrangement of conductors, but with a remote dielectric;  $\epsilon_{eff}$  — is the effective relative permittivity of the medium in the line.

The effective relative permittivity is determined by the geometry of the strip line and the relative dielectric permittivity of the substrate [2]:

$$\epsilon_{eff} = \frac{\epsilon + 1}{2} + \frac{\epsilon - 1}{2} \left( 1 + \frac{10h}{W + \frac{t}{\pi} \left( \ln \frac{2h}{t} + 1 \right)} \right)^{0.1}$$

where  $h$  — is the thickness of the dielectric;  $W$  — is the width of the strip of the conductor;

$t$  — is the thickness of the conductor strip.

## 3. Conclusion

The wavelength in the strip line is determined through the wavelength in free space  $\lambda$  and the effective dielectric constant:

$$\lambda_{av} = \frac{\lambda}{\sqrt{\epsilon_{eff}}}$$

Whence

$$\sqrt{\epsilon_{eff}} = \frac{\lambda}{\lambda_{gr}}$$

$$\epsilon = \frac{2 \left( \frac{\lambda}{\lambda_{gr}} \right)^2 - (1 - P)}{1 + P}$$

Where is the parameter  $P$  determined by the geometric dimensions of the strip and PCB.

Asymmetric Electronic Modeling of the strip line in the AWR Design Environment is shown in fig. 1 and fig. 2.

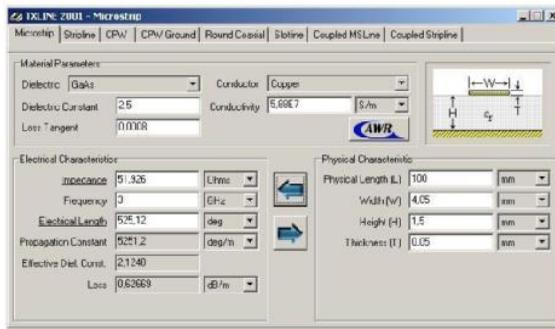


Fig. 1 – Asymmetric Electronic Modeling of the strip line in the AWR Design

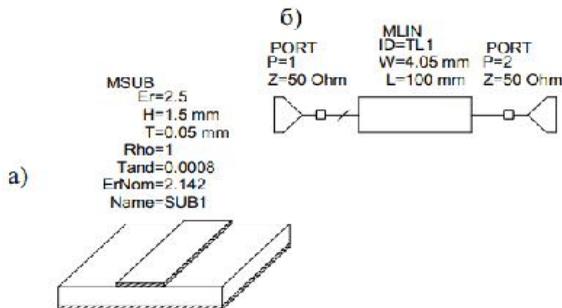


Fig. 2 – Asymmetric Electronic Modeling the strip line

Thus, we proposed a technique for measuring the dielectric parameters of a strip line, which was electronically simulated in the AWR Design Environment.

## References:

1. Измерение диэлектрических параметров полосковой линии/ Невмержицкий М.В. [и др.]// Современные проблемы радиоэлектроники и телекоммуникаций «РТ - 2019». – 2019. – С. 120.

2. Основы проектирования микροэлектронной аппаратуры / Под ред. Высоцкого Б.Ф. — М.: Сов. радио, 1977. – 443 с.

**Аннотация.** Предложена методика измерения диэлектрических параметров полосковой линии. Выполнено электронное моделирование несимметричной полосковой линии в *AWR Design Environment*.

**Ключевые слова:** полосковая линия, контроль параметров, диэлектрическая проницаемость, подложка, микροэлектроника.

**Annotation.** A technique is proposed for measuring the dielectric parameters of a strip line. An asymmetric strip line was electronically simulated in the AWR Design Environment.

**Keywords:** strip line, dielectric parameters, the dielectric constant, substrate, dielectric.

UDC 004.9

## LAB MOCK-UP FOR STUDYING WIRELESS DATA TRANSFER TECHNOLOGY

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## 1. Introduction

In today's world, wireless data transmission is used everywhere. Mobile phones, portable computers, radios, car alarm, unmanned vehicles all, one way or another, transmits and receives data wirelessly. To ensure the availability and development of new devices, qualified specialists are needed. Training such personnel is not an easy task. To facilitate the

training of valuable personnel, a laboratory mock-up was designed to study wireless data transfer technologies.

## 2. Main part

To solve this problem, it was necessary to determine the basis of the laboratory mock-up and modules for data transfer.

The Arduino platform [1] was chosen as the basis as a convenient and simple microcontroller. Three data transmission modules, an RF 433MHz pair transmitter-receiver, a Bluetooth module and a Wi-Fi module [2] were also chosen.

Wi-Fi module needs separate power supply converter 5 to 3.3 volts. Arduino platform and modules are shown on figure 1.



Fig. 1 — Arduino, RF 433MHz module, Bluetooth module and Wi-Fi module.

The basic idea is to combine the modules into a single “shield” for Arduino platform for ease of use in studying. Structural scheme is shown on figure 2.

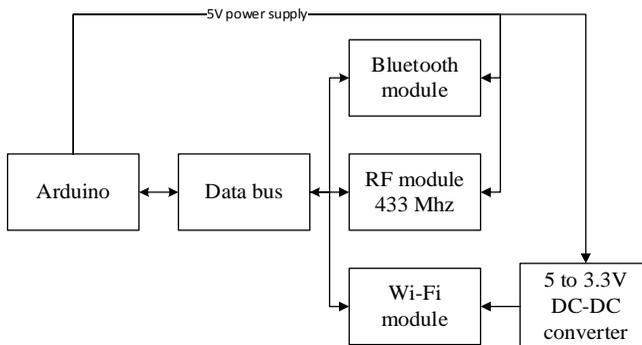


Fig. 2 — Structural scheme.

All modules connected through common data bus with Arduino platform. RF and Bluetooth are supplied 5V from Arduino platform, thanks platform can handle this. For power supply Wi-Fi module is used DC-DC step down converter to lower 5V to 3.3V for correct work.

In future plans, the implementation of the project for the department of “Radioelectronics and Telecommunications” in the framework of WorldSkills Russia

### **3. Conclusion**

Modules for wireless data transmission were considered. The base of the laboratory mock-up and modules were selected. A structural scheme has been developed.

This laboratory model allows you to simply and efficiently study the principles of wireless data transmission using a microcontroller.

### **References:**

1. Arduino Uno Rev3. Arduino. Available at: <https://store.arduino.cc/arduino-uno-rev3>, (accessed 27 April 2020).

2. ESP8266EX\_datasheet / Espressif Systems. Available at: [https://www.espressif.com/sites/default/files/documentation/0a-esp8266ex\\_datasheet\\_en.pdf](https://www.espressif.com/sites/default/files/documentation/0a-esp8266ex_datasheet_en.pdf), (accessed 9 March 2020)

**Аннотация.** Рассмотрены основные технологии беспроводной передачи данных. Спроектирован лабораторный макет для изучения беспроводных технологий передачи данных на платформе *Arduino*.

**Ключевые слова:** лабораторный макет, обучение, беспроводные технологии, микроконтроллер, *Arduino*.

**Annotation.** The basic technologies of wireless data transmission are considered. A laboratory prototype was designed to study wireless data transfer technologies on the *Arduino* platform.

**Keywords:** lab mock-up, studying, wireless technology, microcontroller, *Arduino*.

UDC 621.398

## **AUTOMATIC CONTROL SYSTEM FOR AN UNMANNED AERIAL VEHICLE TO DETECT THE EPICENTER OF A FIRE**

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## 1. Introduction

When extinguishing a forest fire using aircraft, fire service employees face the problem of determining the epicenter of the fire due to high smoke. The smoky layer of the atmosphere prevents the passage of the visible spectrum of light, but does not prevent the passage of the infrared spectrum [2]. To increase the effectiveness of fire suppression, you can use an unmanned aerial vehicle [1] with an automatic control system and an infrared video camera.

The paper presents a block diagram of the automatic control system of an unmanned aerial vehicle, and considers the principle of its operation.

## 2. Main part

The structural diagram of the UAV control system consists of seven functional nodes (Fig. 1): the ATmega2560 microcontroller (MCU); the NRF24L01+ transceiver (TR); the NEO-6M GPS module (GPS); the memory card (MC); the MPU-6050 position sensor (PS), consisting of an accelerometer and gyroscope; servos (S); the motor (M) and telemetry sensors (TS), which include the battery voltage sensor, an atmospheric pressure sensor that acts as an altitude sensor and an ambient temperature sensor.

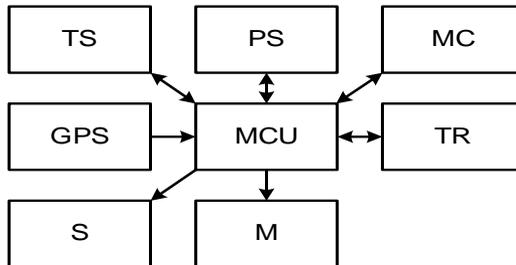


Fig. 1. Block diagram of the UAV control system

Let's consider the principle of operation of the UAV control system. Before departure, the UAV's flight path is recorded on the memory card as an array of coordinates. The launch takes place in manual mode and after reaching the required altitude, the operator switches the UAV to automatic flight control mode, which follows the specified coordinates. If necessary, you can make changes to the UAV's route during the flight. After completing the route, the UAV returns to the take-off point and, while waiting for the operator to switch the flight mode to manual piloting mode, flies at a given altitude along the radius. The operator switches the UAV to manual control mode and makes a landing.

In automatic control mode, the microcontroller analyzes data coming from the GPS module, accelerometer, gyroscope and altitude sensor and, after performing the necessary calculations, sends signals to the servos and motor to correct the speed and course of flight.

During the flight, the onboard video camera of the infrared spectrum records the video image on a dedicated storage device and sends it online via a radio channel to the ground receiver. The image from the UAV's infrared camera is analyzed by the fire service and compared with its current coordinates. Then the coordinates of the epicenter of the fire with its characteristics (area, direction of propagation and terrain conditions) are transmitted to the pilots of aircraft to take active measures to extinguish the fire.

### **3. Conclusion**

The automatic control system of the UAV is aimed at rapid detection of the epicenter of a forest fire. Its use will significantly reduce the search time for the epicenter of the fire, and will reduce the material costs of fire elimination.

#### **References:**

1. Воропаев, Н.П. Применение беспилотных летательных аппаратов в интересах МЧС России / Н.П. Воропаев // Вест. Санкт-Петербур. унив. гос. противопожарной службы МЧС России. – №4. – СПб.: СПб УГПС, 2014. – С. 13-17.

2. Francine Amon и др. Performance Metrics for Fire Fighting Thermal Imaging Cameras – Small and Full-Scale Experiments, Nist Technical Note 1499, National Institute of Standards and Technology, U.S. Department of Commerce, July 2008

3. Система автоматического управления беспилотного летательного аппарата для обнаружения эпицентра пожара/ Сизых Д.А. [и др.]// Современные проблемы радиоэлектроники и телекоммуникаций «РТ - 2019». – 2019. – С. 76.

**Аннотация.** Рассмотрен принцип работы системы автоматического управления беспилотного летательного аппарата для обнаружения эпицентра пожара и разработана структурная схема устройства.

**Ключевые слова:** обнаружение пожара, БПЛА, Контроллер, Автопилот

**Annotation.** The principle of the automatic control system of an unmanned aerial vehicle for detecting the fire epicenter is considered and a block diagram of the device is developed.

**Keywords:** fire detection, UAV, Controller, Autopilot

## SINGLE-BOARD TRANSCEIVER

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**Introduction.** Due to the fact of the trend of development of modern technologies, it is possible to create incredibly compact gadgets. The improvement of SMD technologies has made it possible to produce single-board mini computers, miniature radio modules of the microwave range, which are already used everywhere. On the one hand, these are simple sensors such as Wi-Fi electricity meters, on the other hand, they are wireless headphones and electronic watches.

**Main part.** Digital signal processing (DSP) algorithmization technologies used in digital signal processors (DSP) and field-programmable gate array (FPGAs) make it possible, to process broadband signals in any frequency range in real times.

The block diagram of a single-Board RRD / RTD is shown in Fig. 1.

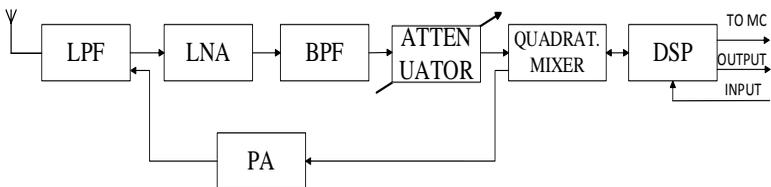


Fig. 1 — Block diagram of a single-Board transceiver

The main working module is a quadrature mixer, which is needed to isolate a useful signal from a mixture of conversion products, and to transfer the spectrum of a low-frequency signal to a given carrier frequency.

The next step is the bandpass signal is received through anti-aliasing filters, which remove higher-order products after mixing the signals and protect against the influence of parasitic signals from higher zones Kotelnikov (Nyquist). After filtering, the bandpass signal is sent to the DSP, where the signal is sampled with further digital processing.

The transmitting part begins with the DSP. This makes it possible to transmit digital data or analog messages (voice, sound).

The extended block diagram of a single-Board RRD / RTD is shown in Fig. 2.

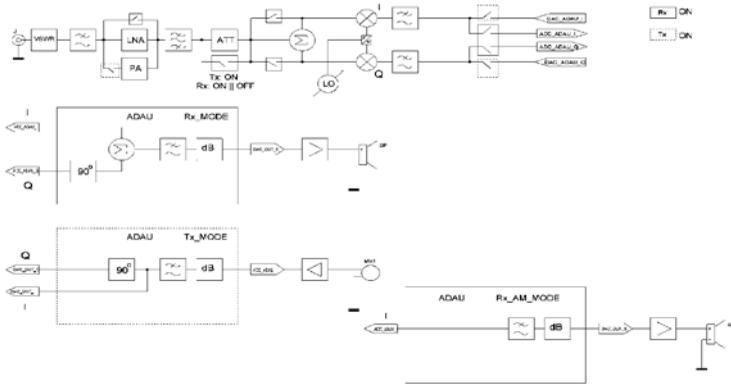


Fig. 2— The extended block diagram of a single-Board RRD / RTD

When digital data is transmitted, the UART or I2C interface is used, via communication between the microcontroller and the PC.

When an analog message is transmitted, for example sound or voice, the signal enters the ADC DSP through a microphone amplifier, and is subjected to digital processing such as changing the spectral composition, equalization, noise elimination, and volume control. Further passes through the FIR-LPF and goes to the DAC, and then to the quadrature mixer, for modulation.

The quadrature mixer works like direct conversion receivers. Figure 3 shows the DSB waveform received at the output of the mixer's I channel.



Fig. 3 – DSB waveform.

The I2C or UART interface provides the possibility of transmitting it to a PC using a microcontroller for further analysis or processing, depending on the type of message being transmitted.

For analog types of transmitted messages such as voice or sound, it is possible to output messages via LPF to the dynamic head, using the built-in DAC.

This scheme was implemented in a printed circuit Board and tested for SSB signal reception from the lower side carrier. The received signal contained voice information. The waveform is shown in figure 4.

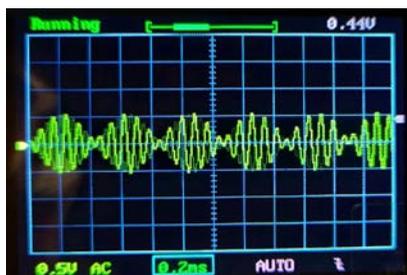


Fig. 4 – Generated SSB signal from the lower side

The advantages of this transceiver are the ability to work in any type of modulation, such as: AM, SSB, FM, PM, FSK, BPSK, QPSK, OQPSK, OFDMA, etc. The user also has the ability to process signals in a digital domain.

**Conclusion.** The DSP imposes a limit on the bandwidth of the received signal, since this DSP family is able to process signals in the band up to 48 kHz at a sampling rate of 96 kHz. This disadvantage can be eliminated by using FPGA, which will significantly increase the bandwidth of the received signal.

#### References:

1. Лайонс Р. Цифровая обработка сигналов / Р. Лайонс. – М.: Бинوم-Пресс, 2011. – 656с.

**Аннотация.** В данной статье кратко изложена структурная схема одноплатного приемопередатчика, описан тракт приема, передачи, а также возможные варианты передачи информации в цифровом или аналоговом виде. Кратко вынесены результаты работы данного устройства при приеме и передаче сигнала в SSB модуляции на нижней боковой полосе. Описаны преимущества и недостатки устройства.

**Ключевые слова:** SDR, РПУ/РПДУ, SMT, ЦОС, приемники прямого преобразования, фазовый метод формирования SSB.

**Annotation.** This article briefly describes the block diagram of a single-Board transceiver, describes the path of reception, transmission, and possible options for transmitting information in digital or analog form. The results of this device operation of receiving and transmitting a signal in SSB modulation on the lower side band are briefly presented. The advantages and disadvantages of the developed device are given.

**Keywords:** SDR, RRD / RTD, SMT, DSP, direct conversion receivers, a phase method for forming SSB.

UDC 625

## **CNC MACHINE CONTROL PANEL**

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### **1. Introduction**

At large enterprises of various industries, digital computing devices are used to control complex production processes and work with mechanical devices (machines). The principle of their operation is based on computer numerical control (CNC). CNC equipment is represented by a wide variety of devices designed for various tasks. Due to its wide functionality and high productivity, in comparison with conventional equipment, CNC machines have a fairly high cost. The combination of these factors and practical experience with this type of machine, makes it necessary to develop a universal control panel.

### **2. Main part**

The developed control panel (CP) consists of a programmable logic controller (PLC), analog (AM) and digital (DM) modules, an operator panel (OP) and manual control elements (CE).

Operator panel is a device designed to configure programs for controlling machine elements (ME): drives, relays, compressors, motors, etc.; and monitoring of various installation parameters.

The block diagram of the control panel is shown in Fig. 1.

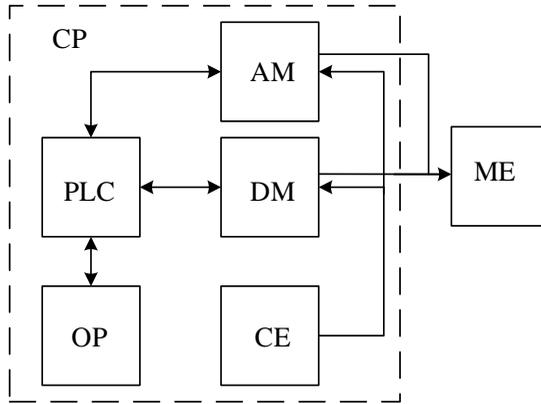


Fig. 1 — Block diagram of the control panel

In case of failure of the operator panel, a set of manual controls is provided. Analog and digital modules are designed to transmit signals from manual controls to the controller and from the controller to the controls of the machine.

For the implementation of the layout of the control panel was chosen controller SIMATIC S7-300 of company SIEMENS.

This controller has a relatively low cost and a number of characteristics necessary for this device:

- support at the level of the operating system of hardware interrupts, processing of hardware and software errors, functions that ensure real-time operation;

- free capacity building during system modernization;

- simple inclusion in various types of industrial networks.

The OP-77A operator panel is selected as the main device for the human-machine interface.

Main features of the selected panel:

- ease of configuration and maintenance;

- wide functionality;

- 23 system keys and 8 freely configurable function keys;

- a set of built-in interfaces (MPI, PROFIBUS DP);

- the presence of a library with a large set of graphical objects.

The next step in the development of the control panel was the creation of an electrical circuit diagram.

Developed circuit is shown in Fig. 2.

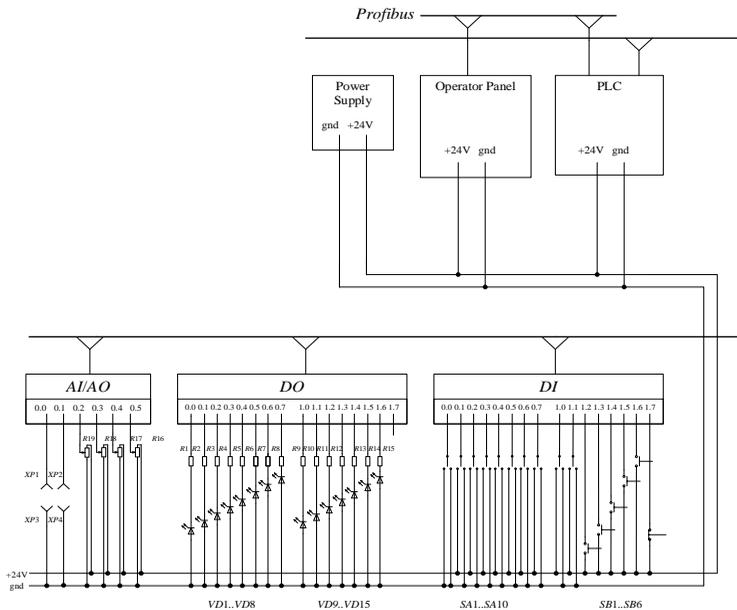


Fig. 2 — Electrical circuit of control panel

Input/output modules are connected to the PLC using a bus connector.

The operator panel is connected to the PLC using the profibus interface

The next step in the development of the device was the creation of a sketch of the control panel. The sketch of the removable part of the control panel is designed in accordance with the ergonomics and technical aesthetics requirements described in GOST (State Standard) 20.39.108-85.

The sketch of the removable part of the control panel is shown in Fig.

3.

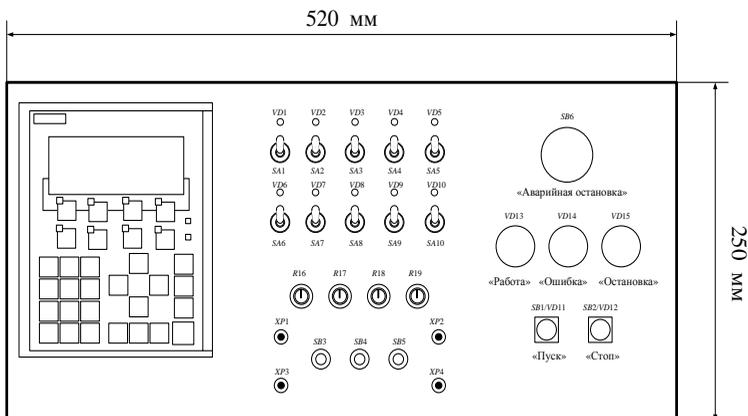


Fig. 3 — Sketch of the removable part of the control panel

The front panel is conditionally divided into 3 parts. On the left side is the Operator Panel — the main device for monitoring and controlling machine elements. In the central part there are manual controls: switches, buttons and potentiometers and a pair of connectors for analog outputs. On the right side are buttons for starting and stopping the operation of the device and elements for indicating the operation of the device.

Based on the developed electrical circuit and sketch of the control panel, a device layout is made. The body and removable part are made of aluminum. Some parts are replaced by domestic counterparts. PLC with modules is mounted on a DIN rail in the device body and connected via bus to elements located on the removable part of the device.

Appearance of the layout of the control panel is shown in Fig. 4.



Fig. 4 — Appearance of the layout of the control panel

### 3. Conclusion

The developed control panel is a universal device for CNC machines, which reduces the costs of production, operation, training of specialists, facilitates and accelerates the repair of plants. The disadvantages of the control panel are the relatively obsolete OP-77A operator panel and the need for specialized personnel for reconfiguring the PLC for a specific installation and task.

The implemented control panel layout passed health tests at the physical and software levels. The model is provided to the enterprise for testing under working conditions.

#### References:

1. Панель управления станка с ЧПУ/ Янковский С.И. [и др.]// Современные проблемы радиоэлектроники и телекоммуникаций «РТ - 2019». 2019. – С. 146.
2. SIMATIC S7-300 S7-300 Module data [Электронный ресурс] / Siemens. – Режим доступа: <https://support.industry.siemens.com/cs/document/8859629/simatic-s7-300-s7-300-module-data?dti=0&lc=en-WW>.

**Аннотация.** Рассмотрен принцип числового программного управления для работы со сложными механическими устройствами. Спроектирована универсальная панель управления станками с ЧПУ. Изготовлен прототип панели управления.

**Ключевые слова:** панель управления, станок с ЧПУ, оператор, программируемый логический контроллер.

**Annotation.** The principle of numerical control for working with complex mechanical devices is considered. Universal control panel CNC machines is designed. The prototype of the control panel was made.

**Keywords:** control panel, CNC machine, operator, programmable logic controller.

## SECTION 2. INFORMATION SYSTEMS AND TECHNOLOGIES



UDC 621.372.211

### HUMIDITY METER OF CONCRETE PRODUCTS

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#### 1. Introduction

A method for determining humidity using a balance bridge is known, but it has a large measurement error due to insufficient decoupling between the arms of a double waveguide tee. Even with careful tuning of the double waveguide tee, it is not possible to achieve a satisfactory agreement in a wide frequency band, and the decoupling between the shoulders in rare cases reaches 25 dB.

The method for determining humidity based on measuring the modulus of the reflection coefficient of the wave from the surface of the test sample using a reflector meter is more broadband. The degree of isolation between the channels of incident and reflected waves in the reflector meter reaches more than 30 dB for conventional couplers. Unfortunately, in the area of small values of the reflection coefficient module (at low humidity of the object), the error is unacceptably large, since the level of the parasitic signal due to the final direction of the reflected wave coupler is commensurate with the level of the useful component. In addition, the reflected wave carries information only about the humidity of the surface of the concrete product.

An analysis of the literature shows that the most suitable method for controlling the humidity of concrete products is one of a wave passing through the object under study, which carries information about humidity along the entire section of the product [1].

## 2. The research of passing wave method

While analyzing the method of passing wave, it is reasonable to assume that the front of the wave falling on the material is flat and the dielectric is isotropic. The wet material can be considered as a three-component flat model [2, 3]. In this case, the volume of air in the pores of the material will be equal to

$$V_{II} = 1 - V_B - V_C.$$

Taking the density of water as a unit, we get  $V_B = Q$ ,

where  $Q$  — volume moisture.

According to the accepted model, the wet material is represented as consisting of three flat layers of water, dry matter and air of infinite extent. Then the equations for  $\alpha$  and  $\beta$  are written as:

$$\alpha = \alpha_B = Qk + \alpha_C V_C + \alpha_{II} (1 - V_B - V_C); \quad (1)$$

$$\beta = \beta_B = Qk_1 + \beta_C V_C k_2 + \beta_{II} (1 - V_B - V_C) k_3, \quad (2)$$

where  $\alpha_B, \alpha_C, \alpha_{II}$  — attenuation coefficients of water, dry matter and air accordingly;  $\beta_B, \beta_C, \beta_{II}$  — wave numbers of the corresponding components;  $Q$  — volume moisture;  $V_C$  — volume of dry substance;  $k, k_1, k_2, k_3$  — empirical constants taking into account the structure of the material.

Due to the fact that usually  $\alpha_{II} \ll \alpha_C \ll \alpha_B$  [3] expression (1) for the conversion function can be simplified

$$\alpha = \alpha_B Qk = \alpha_B W \rho' k,$$

where  $W$  — comparative humidity;  $\rho' = \frac{\rho_{BM}}{\rho_B}$  — the reduced density, numerically equal to the density of the wet material.

Since the measured parameter is the attenuation of microwave energy in a wet material, we write down the equation of the relationship between attenuation and humidity.

$$N = 8,686(\alpha_B W \rho' k l + \Gamma - \Gamma e^{-2\alpha l} \cos 2\beta_2 l), \quad (3)$$

where  $N$  — measured attenuation, dB;

$G$  — modulus of the reflection coefficient of the interface between two media (air-material);

$l$  — thickness of the wet material;

$\beta_2$  — phase number of the wet material.

Analysis of formula (3) shows that the solution of this equation concerning  $W$  is ambiguous due to the presence of reflections. However, with sufficiently large thicknesses of the material under study

$$Q \geq 0,1 \cdot e^{-2\alpha l} \ll 1$$

the third summand can be ignored in equation (3).

In this regard, we will finally write (3) in the following form

$$N = 8,686 \cdot \alpha_B W \rho' k l + \Gamma \quad (4)$$

Solving equation (4) concerning  $W$  we have

$$W = \frac{N - 8,686 \cdot \Gamma}{8,686 \cdot \alpha_B \rho' k l} \quad (5)$$

Analysis of formula (5) shows that the humidity of the measured material depends on its density, so the implementation of the method under consideration requires a measuring converter that controls the density of the object of study with the current humidity value at the time of determining the density.

The volume of concrete samples is determined by their geometric dimensions. If the shape of the castings is correct, then use a ruler or caliper with an error of less than 1 mm. The measurement method is given in GOST 10180. When weighing, the permissible error should not exceed (according to GOST 10180, GOST 12739.1-78) a tenth of a percent. The density for a sample with a controlled mass is calculated as the ratio of this mass to volume multiplied by 1000. The mass is expressed in grams, and the volume in  $\text{cm}^3$ .

Fig. 1 shows a block diagram for measuring humidity and density of a monolithic concrete product.

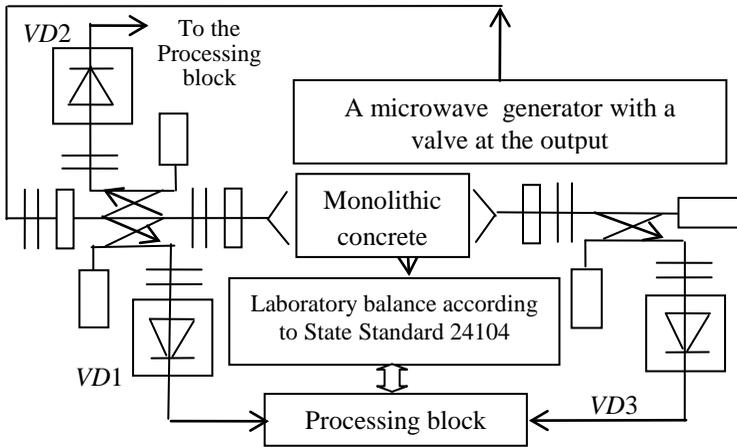


Fig. 1 — Concrete humidity meter with density control of a monolithic concrete product

Then formula (5) can be rewritten as follows

$$W_0 = \frac{10 \cdot \log \frac{U_{\mu 1} - \Gamma}{U_{\mu 3}}}{8,686 \cdot \alpha_B \rho' k d} \quad (6)$$

Thus, an expression is obtained that relates the humidity of the concrete researched sample with voltage at the outputs of microwave detectors of falling, passing and reflected electromagnetic waves and the parameters  $\alpha_B, \rho', k, d$ .

### 3. Analysis of errors in measuring humidity of concrete products

The analysis of the dependence  $\delta_w$  on errors due to inaccuracy of measurement: voltages  $U_{\mu 1}, U_{\mu 3}$ ; density; thickness of concrete and modulus of the reflection coefficient from the interface of air-concrete media at low values of humidity  $W$  (about one 1.0 %) is not more than 2.0 %. As humidity increases, the relative error monotonously decreases to 1.3 %. The result meets modern requirements for the production of concrete products [3].

### 4. Conclusion

The conducted research of the passing wave method allows to make the following conclusions:

— the comparative measurement error due to the inaccuracy of determining the voltage at the output of the microwave detector of the passed wave at low values of humidity  $W$  of concrete reaches one percent, and at values close to 100 % it does not exceed 0,02 %.

- comparative deviation of measurement due to the inaccuracy of determination of density  $\rho$  of the concrete sample in the entire humidity range from zero to 100% does not exceed  $\pm 1$  %;
- comparative deviation of measurement due to the inaccuracy of determining the thickness  $d$  of the concrete sample in the entire humidity range from zero to 100% does not exceed  $\pm 1$  %;
- comparative deviation of humidity measurements due to inaccuracy of module definition of reflection coefficient from the interface of the media, the air-concrete of the test sample does not exceed one percent in the area of its small values, and when  $G$  tends to one, it monotonously approaches one hundredth of a percent.
- result the error of measuring the humidity  $W$  of concrete does not exceed 2.0% in the area of low humidity values and monotonously decreases to one tenth of a percent at  $W$ , close to 100 %, which meets the requirements for meters operating in the quality control mode of concrete products at the final stage of their manufacture.

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**Аннотация.** Анализ литературы показал, что микроволновые методы измерения влажности изделий из бетона в настоящее время являются наиболее востребованными. Очевидно, что для оптимизации методики измерения влажности этих изделий целесообразно выбирать такой метод и аппаратуру на его основе, которые бы повышали производительность труда на предприятии без снижения качества продукции. Не менее важным являются точность измерения и надежность аппаратуры в производственных условиях, в которых много дестабилизирующих факторов, обусловленных окружающей средой, недостаточной квалификацией обслуживающего персонала.

Измерительная аппаратура на основе метода рефлектометра, как известно, отличается широкополосностью и простотой реализации. С точки зрения точности и информативности предпочтительным

является измеритель, получающий информацию о влажности в основном из прошедшей волны. Цель данной работы — повышение точности измерений.

В результате проведенного анализа определены составляющие погрешностей, обусловленных неточностью измерения напряжения СВЧ детекторов, плотности бетона, и модуля коэффициента отражения электромагнитной волны от поверхности раздела сред воздух бетон. По расчетам результирующая погрешность измерения влажности бетона не превышает 2,0 % в области малых значений влажности и монотонно снижается до одной десятой процента при влажности, близкой к 100 %, что соответствует современным требованиям для измерителей, работающих в режиме контроля качества изделий из бетона на заключительном этапе их изготовления.

**Ключевые слова:** СВЧ генератор, двунаправленный ответвитель, ответвитель прошедшей волны, измеренное затухание; толщина влажного материала; СВЧ детектор, передающая рупорная антенны, приемная рупорная антенна, погрешность измерения, весы лабораторные.

**Annotation.** Analysis of the literature has shown that microwave methods for measuring the humidity of concrete products are currently the most popular. It is obvious that to optimize the method of measuring the humidity of these products, it is advisable to choose a method and equipment based on it which would increase labor productivity at the enterprise without reducing the quality of products. Equally important are the accuracy of measurement and reliability of equipment in production conditions, in which there are many destabilizing factors due to the environment, insufficient skills of service personnel.

Measuring equipment based on the reflector meter method is characterized by broadband and ease of implementation. From the point of view of accuracy and informativeness, a meter that receives information about humidity mainly from the past wave is preferable.

The purpose of this work is to improve the accuracy of measurements.

As a result of the analysis, the components of errors due to inaccuracies in measuring the voltage of microwave detectors, the density of concrete, and the modulus of the reflection coefficient of the electromagnetic wave from the interface between media and concrete were determined. According to calculations, the resulting error in measuring concrete humidity does not exceed 2.0% in the area of low humidity values and monotonously decreases to one tenth of a percent at humidity close to 100%, which meets modern requirements for meters operating in the mode

of quality control of concrete products at the final stage of their manufacture.

**Keywords:** microwave generator, bidirectional coupler, past wave coupler, measured attenuation; thickness of wet material; microwave detector, transmitting horn antenna, receiving horn antenna, measurement error, laboratory scales.

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## **CONTROL IN THE CITY WITH ANALYTICAL VIDEO SURVEILLANCE**

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**Introduction.** Nowadays, the sphere of analytical video surveillance is rapidly developing. If previously video surveillance systems were used only to ensure the safety of some objects, now their information collected from huge distributed video surveillance systems finds application not only for security but also for automatic analysis in marketing, transport, urban economy, allows to structure, filter, highlight the main thing in endless information flows.

The main advantage of modern systems is the ability to analyze the image in a frame with a clearly defined goal. For example, today, due to the spread of new coronavirus infection (COVID-19), the algorithms of monitoring epidemiological measures have become particularly relevant:

- contactless measurement of body temperature;
- recognition of the presence of masks on the face;
- facial recognition in a mask;
- monitoring the implementation of quarantine measures;
- contactless control of access to any objects;

- disinfection quality control.

**Materials and methods.** Based on analytical video surveillance systems, hardware and software complexes "Safe City" are being created, which together solve many problems of security in the city: protection of strategic facilities, fight against crime and terrorism, prevention of accidents and man-made accidents, fight against transport violations and epidemiological control. Such hardware and software systems include video recording, video digitization and information analysis, signaling, environmental monitoring, information delivery, data distribution, alerts [4].

Images from all video cameras and sensor data are transmitted to a single server of the Information Processing Center. Events are placed on long-term storage in compressed form. To find the required event in the archive, the system automatically systematizes the data and records not only video fragments but also meaningful descriptions to them. By filtering by category, you can find any types of events, group them together, study them in detail, and draw conclusions. Events are displayed on maps of the area (including the 3D model). In online analysis, cameras can focus to the point of the event and be directed towards the triggered sensors. The results of the analysis and forecasting of the situation are recommendations, the implementation of which by city services significantly improves the safety and comfort of residents.

Producers of "Safe City" in Russia:

- SPECLAB;
- VOCORD;
- BEWARD;
- Radiotelekomunikacii Engineering Company (RTK);
- DSSL (TRASSIR technology);
- Bezopasnyj gorod and Krymskie sistemy bezopasnosti.

**Results.** Let's consider and compare examples of the implementation of technologies that are relevant today.

1. Contactless measurement of body temperature. The measurement of body temperature using infrared sensors has been the most widespread, and systems combining observation in visible and infrared light with different cameras (conventional camera and thermal imager) can provide the best assessment of human condition - they use different analytics: Conventional chamber selects face, selects optimal distance for temperature measurement, and thermal imager qualitatively determines temperature in specified zone. Such decisions are applied stationary in conditions of the large flow of people. For point determination of temperature it is possible to use also qualitative but significantly more budgetary analog: IP-terminal

BEWARD TFR80-210T1, which appeared on the market in April 2020, allows contactless measurement of body temperature. It only takes 0.3 seconds. This terminal supports 4 access criteria - by card, face, body temperature, and presence of a mask. The facial recognition algorithm works using Bi-Scan technology, which completely eliminates the possibility of passing through photographs. The terminal measures the body temperature of the person approaching, checks the presence of the mask, and generates an alarm signal in case of any violations [1].

2. The presence/absence of a mask can both be a separate purpose of analytical operations and significantly affect related algorithms: facial recognition in the conditions of hiding most of it until recently was considered an extremely difficult task, many algorithms relied on the mimics and location of special points in the area of the nasolabial triangle. In normal conditions, the correct operation of algorithms is assisted by organizational measures - it is mandatory to pass the control in sunglasses or with a low-pressure visor cap but the presence of a mask is recognized under the current conditions. In the context of countering the epidemic, the developers of analytical algorithms focused on facial recognition on the remaining open areas and achieved significant successes by analyzing more characteristic points around the eyes of the companies represented on the Russian market, only NtechLab, involved in the development of Safe City technologies in Moscow, presented a solution for the recognition of masked faces but it is noted that it is aimed at the recognition of faces characteristic of Asia, the Middle East and Latin America, which indirectly confirms some lag of Russian developers, We hope temporarily. As such algorithms will be in demand after the reduction of the severity of epidemiological measures, as the recognition of partially masked faces has always been a challenge to security. Also, masked facial recognition will be required for contactless access to objects, as these technologies, like iris recognition, are most suitable for minimizing contacts.

3. The chemical protection neural network IP- Concierge (SPECLAB) [2] was also established in April this year to control the quality of disinfection. The treatment of living quarters with disinfectants has become a necessary measure in modern times. The problem is the quality control of this process. The neural network from the SPECLAB can solve this problem, the intelligent algorithm automatically calculates the rate of filling and direction of work. Such analytics does not require much investment, as it uses video surveillance equipment already installed, adding only new analysis functions.

Such technologies are implemented with the help of neural networks of the Analytical Center.

Neural network consists of many interacting neurons and connections between them, synapses – in biology. In computer analytics, a neural network is a system of connected and interacting computational units (simple processors – artificial neurons). Each neuron of such a network deals only with signals it periodically receives and signals it periodically sends to other neurons - processors. Connected into a sufficiently large network with controlled interaction, such individually simple processors together can perform quite complex tasks. Neural networks are not programmed in the normal sense of the word, they are trained. Learning is one of the main advantages of neural networks over traditional algorithms. Technically, such training consists of finding the coupling coefficients between neurons. In the course of training, the neural network can detect complex dependencies between input data and output data, as well as perform generalization.

The most common applications of neural networks are:

- classification – distribution of data on parameters;
- prediction – possibility to predict changes of analyzed data system;
- recognition – selecting objects with specified characteristics.

One of the most important tasks in security systems is to ensure reliable network operation, information protection, and correct resource allocation. Modern video surveillance networks have a decentralized structure. The network architecture must have an automatic protection system for network elements. The reservation is provided for three directions: the transmitting video server, the message path, and the receiving archive-analyzer. The transmitter performs video detection and, depending on the activity in the frame, changes the quality of the streams by regulating traffic. Neural networks, like other devices that implement analytical functions, are on the receiver side to be able to analyze the situation as a whole taking into account the data coming from many sources. The network allows resources to be reallocated between work elements of the system without human involvement, if some of them are breaking down for any reason. Each of the network elements has in its composition an intelligent part controlling such change of functions.

**Conclusion.** The Safe City system is a set of technical means of controlling the safety of citizens and public order. At present, this sphere is rapidly developing. New technologies aimed at improving security are being created. Based on the analysis of the development of the situation in the countries of Asia, effectively suppressing the spread of infection, and comparison with our region, it can be noted that most of the activities carried out are relevant and effective but there is a direction that is unrealized and does not require super-cost. Information about places of

detection of patients, quarantine violators or requirements for safe behavior, for example, accumulation of people, obtained with the help of cameras and other sources of information of hardware and software complex "Safe City," can be marked on maps available to the population (for example, in the form of a layer on Yandex-maps). Information can be displayed using timestamps, such as color saturation. As long as the number of cases is small, it would very effectively allow people to avoid potentially dangerous places for some time and move more freely in clean zones.

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**Аннотация.** В статье анализируется направление развития технологий систем аналитического видеонаблюдения в АПК «Безопасный город» в условиях возрастания требований эпидемиологического контроля. Рассмотрены новые требования, предъявляемые к качеству наблюдения, и различные варианты решений для контроля температуры, наличия средств защиты, бесконтактного доступа и дезинфекции. Предложено использовать информацию об карантинных зонах для он-лайн информирования населения, обеспечивающего минимально необходимое безопасное перемещение в городе.

**Ключевые слова:** система видеонаблюдения, аппаратно-программный комплекс «Безопасный город», нейросеть, безопасность, технологии эпидемиологического контроля.

**Annotation.** The article analyzes the direction of the development of analytical video surveillance systems technologies in the Hardware and software complex “Safe City” in conditions of increasing requirements of epidemiological control. New requirements for quality of observation, and various solutions for temperature control, availability of protective means,

contactless access and disinfection are considered. It is proposed to use the information on quarantine zones to inform the population online, ensuring the minimum necessary safe movement in the city.

**Keywords:** video surveillance system, hardware and software complex “Safe City”, neural network, security, epidemiological control technologies.

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## **CALCULATION OF PARAMETERS OF BROADBAND AMPLIFIERS IN THE FIELD OF THE SMALL TIMES**

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**Introduction.** The greatest difficulties in constructing broadband amplifiers are associated with ensuring the constancy of the gain in the high-frequency region. The main reasons leading to a decrease in the gain at high frequencies are: deterioration of the amplifying properties of transistors and the influence of stray capacitances of the circuit. To compensate for the decrease in the gain, special frequency correction circuits are introduced into the amplification stages, which ensure the expansion of the band of equally amplified frequencies and reduce the distortion of the waveform. The most common is the inductive high-frequency correction circuit.

In the literature [2, 3] the issues of the influence of correction circuits in broadband cascades on the amplitude-frequency characteristic of a cascade are considered, however, the problems of the influence of correction circuits on the transition characteristic of a cascade in the region of small times are not considered fully enough. The aim of the work is to consider the influence of cascade correction circuits with inductive high-frequency correction on the time of establishment of a pulse input signal.

## Materials and Methods

In a broadband amplifier with inductive high-frequency correction (Fig. 1), the equivalent collector load resistance increases with increasing frequency, this leads to an increase in the upper cutoff frequency, an increase in the gain area of the cascade, and also a decrease in the rise time of the pulse front.

During the analysis, a complex gain of the circuit with inductive high-frequency correction was found, then the Laplace transform was used to find the temporal characteristics.

The calculations were carried out on a personal computer using MathCAD 14 program.

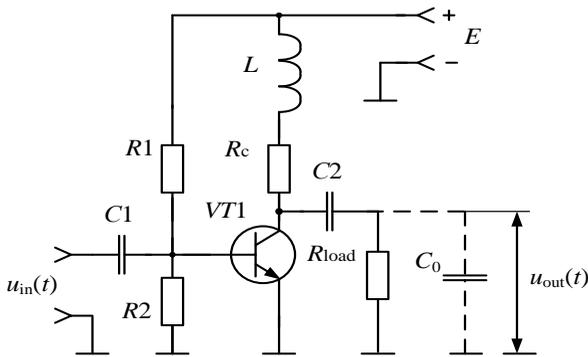


Fig. 1. The scheme of the cascade with inductive high-frequency correction

## Results and Discussion

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  $R_{load} \gg R_c$  is fulfilled [1]. With this in mind, in fig. 2 shows an equivalent circuit of the output circuit of a cascade. The equivalent circuit also shows the parasitic capacitance of the cascade ( $C_0$ ), which affects the amplitude frequency response in the high-frequency region. It is seen that the load of the cascade is a parallel resonant circuit formed by the elements  $LR_cC_0$ .

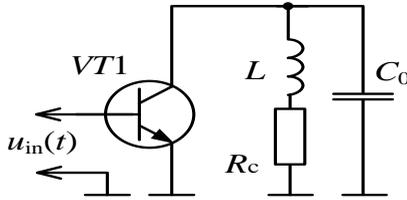


Fig. 2. The equivalent circuit of the output circuit

As a result of the analysis, an expression was obtained for the complex coefficient of gain in the high-frequency region

$$K(j\omega) = K_0 \frac{1 + j\omega m \tau}{1 + j\omega \tau + (j\omega \tau)^2 m} , \quad (1)$$

where  $K_0$  – coefficient gain in the mid-frequency region;  $m = \frac{L}{R_c^2 C_0}$  – the correction factor;  $\tau = R_c C_0$  – output circuit time constant;  $C_0$  – cascade output circuit capacity.

Applying the Laplace transform to expression (1), an image of the coefficient gain was found, and then the characteristic equation was obtained

$$p^2 \tau^2 m + p \tau + 1 = 0 . \quad (2)$$

The analysis of the characteristic equation (2) showed that with a correction coefficient  $m = 0,25$ , a critical mode of operation is observed. In this mode, the duration of the pulse front will be minimal at which there is no front surge. With an increase in the correction coefficient  $m > 0,25$ , the duration of the front decreases, but a surge of the front appears.

Using expression (1), provided that a single voltage step was applied to the input of the cascade, an image of the output voltage was found

$$U_{\text{ВЫХ}}(p) = U_0 \frac{pm\tau + 1}{p(p^2 \tau^2 m + p\tau + 1)} , \quad (3)$$

where  $U_0$  — steady-state voltage at the output of the amplifier stage.

Applying the inverse Laplace transform to the found expression (3), we obtained the transient characteristics of the cascade (Fig. 3). The calculation was carried out for the following cases: No high-frequency correction ( $m = 0$ ), critical mode ( $m = 0,25$ ), maximum flat frequency

response mode ( $m = 0,414$ ), and also the override mode ( $m = 1,0$ ). When calculating the transient characteristics, it was assumed that coefficient gain in the middle frequency region is  $K_0 = 10$ .

$$u_{out}(t)/U_0$$

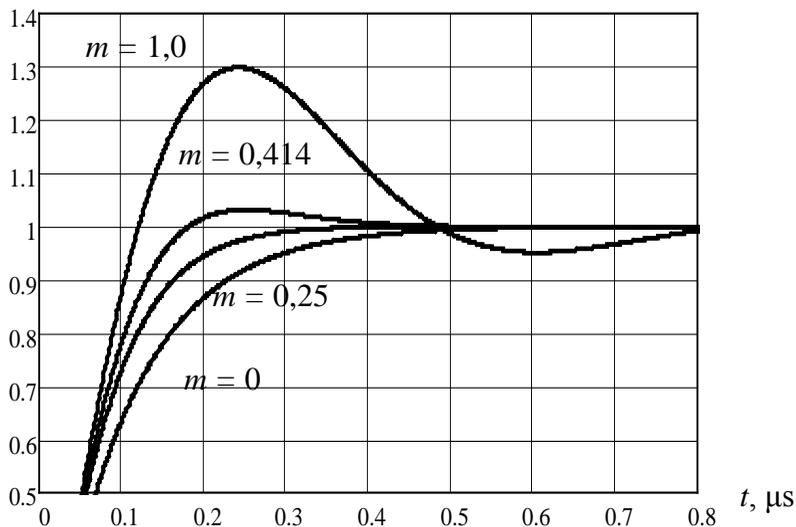


Fig. 3. Transient characteristics of the cascade with inductive correction in the field of small times

Calculations showed that for  $m = 0,414$  the front surge is 3 %, for  $m = 1,0$  the front surge reaches 30 %. This can be used for mutual compensation of distortions of the pulse front in multi cascade amplifiers.

**Conclusions.**

An analysis of the cascade with inductive high-frequency correction in the region of small times is carried out, as a result of which it is obtained that when introducing a correction corresponding to the maximum flat frequency response, the front surge is 3 %. In multistage amplifiers, to obtain mutual correction of transient distortions in the region of small times, it is necessary to use a correction coefficient  $m > 0,25$ .

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**Аннотация.** Проведен анализ схемы индуктивной высокочастотной коррекции в области малых времен. Найдено выражение для комплексного коэффициента усиления каскада и его изображение по Лапласу.

Анализ полученного характеристического уравнения позволил найти значение коэффициента коррекции, при котором скорость нарастания выходного напряжения максимальна, но отсутствует выброс фронта прямоугольного импульса на выходе.

Получены выражения для расчета зависимости выходного напряжения от времени при подаче на вход единичного скачка напряжения. Приведены переходные характеристики усилительного каскада в области малых времен, а также рассчитан выброс фронта усиленного напряжения для различных значений коэффициента коррекции.

**Ключевые слова:** широкополосные усилители, индуктивная коррекция, длительность фронта, выброс фронта.

**Annotation.** An analysis of the inductive high-frequency correction scheme in the field of small times was carried out. An expression is found for the complex gain of the cascade and its image according to Laplace.

An analysis of the obtained characteristic equation made it possible to find the value of the correction coefficient at which the duration of the pulse front of the output voltage is maximum, but there is no ejection of the front surge of a rectangular pulse at the output.

Expressions are obtained for calculating the dependence of the output voltage on time when a single voltage jump is applied to the input. The transient characteristics of the amplification stage in the region of small times are given, and the ejection of the amplified voltage front for various values of the correction coefficient is calculated.

**Keywords:** broadband amplifiers, inductive correction, duration of the pulse front, front surge.

## RISK ASSESSMENT METHODS AND VISUALIZATION

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Often, the concept of risk is used in the business and economic spheres of activity, but in the system-technical areas, risk also plays a significant role. Risk analysis is the process of systematically using information to assess risk and develop appropriate measures. The information used may include data from the company's accumulated experience, theoretical calculations, and the results of analyzing the judgments of specialists, managers, and other involved persons.

There are several modern and promising approaches to risk assessment: using stochastic evaluation criteria, Markov-oriented copulas, quantitative estimates, etc [1-4].

A Markov model visualization product such as heat maps can also be used to solve this problem. It is also possible to use this tool to assess the risks of an unpromising condition.

If there is a time factor in the framework of the Markov model of some complex system, can be used visualization of time distributions to assess risks.

The following methods of risk assessment were identified:

1. Stochastic risk assessment
2. Quantitative risk assessment
3. Copula-based risk assessment models
4. Risk assessment using visualization heat maps
5. Risk assessment using time distributions for each of the states.

The concepts of prospective and non-prospective states are introduced for further understanding of risk assessment methods. A prospective state means a situation in which the onset of a certain state is planned and does not lead to the formation of any negative factors in the functioning of the system. Non-prospective state is one where onset is accompanied by a negative impact on the overall operation of the system, thereby causing cycles, stagnation, critical errors, in particular, the termination of the system.

Since risks are most often assessed at the initial stages of the system operation, it is also possible to assess risk situations using the visualization of heat maps in the framework of the Markov model. It is important to note that heat maps for risk assessment can be used if the system is not in stationary mode. As a demonstration example, see a typical heat map for a three-state system (Fig.1).

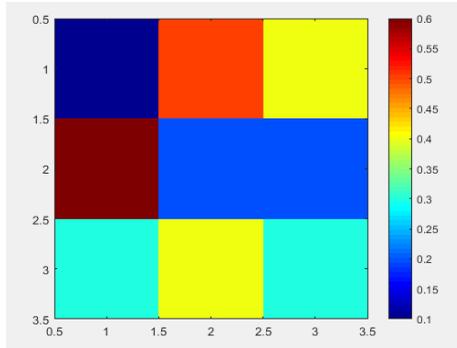


Figure 1– Initial heat map for a three-state system

The initial thermal plane is divided into 9 squares that characterize the probability of transition from one state to another. Color spectra characterize the increase in probability for a particular transition. If, for example, the probability of an unpromising state is high, the square corresponding to the transition to this state will turn red on the heat map. In this way, you can clearly detect the situation in which a risky one occurred. It is natural that when transitions are implemented, the Markov model will start aiming at a stationary mode, as a result of which the spectra become smoothed, and this makes it difficult to assess the risk.

Using semi-Markov distributions for risk assessment is applicable if the prospects of a particular state can be correlated with the time of the system in this state. The semi-Markov model is characterized by the presence of a time distribution, which allows to estimate the average time spent by the system in each state. Let's assume that data about the states of system was obtained as a result of a certain time interval. The result is shown in table 1 below.

Table 1 – Data obtained due to some system operation

State number	Average time in the state	Number of state transitions
1	43	3
2	67	14
3	25	6

Evidently, table 1 shows that system has 3 states. It is worth noting that the operation of this system was not initially divided into promising and non-promising states. Obviously, the number one state is the most expensive. For one pass, the system spends an average of 129 conventional units of time in it, which automatically at first glance includes this state in the group of unpromising, however, there is a state 2, which the system goes to much more often than to state 1, and the total average time spent in this state is the greatest. It means that the system will spend most of its resources on state 2, which is also undesirable.

Therefore, visualization of time distributions in the semi-Markov model allows to see possible unpromising states in terms of time consumption.

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**Аннотация.** Существует множество подходов к построению моделей анализа риска, в частности подобные механизмы могут быть представлены в виде стохастической оценки рисков, на базе информации о состояниях системы на протяжении её жизненного цикла. Полученные математические характеристики позволяют оценить дефектогенность, дефектабельность и дефектоскопичность рассматриваемого объекта. Качество ИС напрямую связано с рисками возникновения дефектов, проявляющимися в процессе эксплуатации. Свойства ИС, в том числе и дефектологические, могут проявляться лишь во взаимодействии с внешней средой, включающей технические средства, персонал, информационное и программное окружение.

Настоящее исследование позволяет на основе подготовленной визуализации сложной системы на базе модели Маркова оценить риски возникновения неперспективных состояний, ведущих к общей деградации.

**Ключевые слова:** риск, стохастическая оценка риска, тепловая карта, полумарковское распределение.

**Annotation.** There are many approaches to building risk analysis models. In particular, such mechanisms can be presented as a stochastic risk assessment based on information about the state of the system throughout its life cycle. Obtained mathematical characteristics allow evaluation of the defectogenicity, defectability and flaw detection of the considered object. The quality of the information system is directly related to the risks of defects occurring during operation. Information system features, including defectological ones, can only appear (или occur) in interaction with the environment, containing technical devices, staff, information environment and software.

This study allows to evaluate the risks of non-promising states leading to general degradation with the prepared visualization of a complex system based on the Markov model.

**Keywords:** risk, stochastic risk assessment, heat map, semi-Markov distribution.

UDC 004

## **QUALITY OF MOBILE APPS AND THEIR ARCHITECTURE**

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Against the backdrop of the massive and large growth of the mobile device market, most people have a mobile device, otherwise called a smartphone. Unlike desktop computers, where web solutions are more popular, for example, sites with news, video, communication, and mobile applications are more popular on smartphones.

The needs of users are quite extensive. Given such a huge number of applications, it can be quite difficult for the average consumer to choose a software product that meets their needs and the proper level of quality and security. To understand this variety of applications, you can use research, which requires ratings and ratings. In turn, for research, standards and test procedures are required [1].

There are many standards that are created for evaluating software, but for mobile applications only conditional and recommended existed. The

publishers of such standards were most often smartphone makers or software developers [2].

So, for the Android operating system, Google has created a document that helps to evaluate the main aspects of the quality of your application, using a compact set of basic criteria for the quality of applications and related verification procedures. There are also sections that are designed for specific solutions, such as adaptation for tablets or smart watches.

First of all, it is recommended to adhere to criteria such as:

1) graphic design and user interaction (standard design of interface elements, animation, user interaction, navigation in the application and working with notifications);

2) functionality (permissions to device resources, installation location, sound interaction, processing of possible cases of using the device, for example, in the background or screen rotation);

3) performance and stability;

4) compliance with the requirements of the Google Play app store (policies, application information, user support);

5) setup and testing procedures (a set of tests, techniques and tools that can help in detecting various types of problems with application quality).

There are official standards that apply to software development. In 2018 [3] RosKachestvo developed the national standard PNST 277-2018 "comparative testing of mobile applications for smartphones". This standard sets out the requirements and characteristics of the object of comparative testing-mobile applications for smartphones in order to provide information to consumers that will help them make an informed choice that meets their needs. The main quality characteristics of mobile apps are:

1) functionality;

2) ease of use;

3) performance and reliability;

4) security.

You can apply the standards used in software engineering to mobile app development. The ISO/IEC international standard defines three related software quality models (ISO 9126-01 Software Engineering):

➤ internal quality;

➤ external quality;

➤ quality during operation, as well as a set of related software quality assessment activities (ISO14598-98 Software Product Evaluation).

As you can see above, many standards often define similar qualities. However, there are specialized quality models that can be applied directly during development as part of the development methodology. These are the McCall and FURPS models.

McCall tries to bridge the gap between users and developers by focusing on a number of software quality factors that reflect both user views and developer priorities. The McCall quality model considers three main directions for determining and identifying the quality of a software product:

- 1) product revision (ability to change);
- 2) product transition (adaptability to new environments);
- 3) product operations (its performance characteristics).

The product revision includes maintainability, flexibility (ease of making changes necessary for changes in the operating environment), and testability. Migrating to a product is portability (the effort required to migrate a program from one environment to another), reusability (the ease of reusing software in a different context), and compatibility (the effort required to connect a system to another system). The quality of product operations depends on correctness (the degree to which the program fulfills its specification), reliability, efficiency, integrity (protecting the program from unauthorized access), and usability.

The main concept behind the FURPS quality model is the decomposition of software characteristics into two categories of requirements. The FURPS acronym used in the model designation indicates the following categories of SOFTWARE quality requirements:

- Functionality – features, features, security;
- Usability – human factor, ergonomics, user documentation;
- Reliability – failure rate, information recovery, and predictability;
- Performance – response time, throughput, accuracy, availability, and resource usage;
- Supportability – testability, extensibility, adaptability, maintainability, compatibility, configurability, serviceability, installation requirements, and localizability.

When developing a mobile application "Мобильный СевГУ" was applied to the FURPS model. During the two years of operation of the "Мобильный СевГУ" application, such features were identified that require improvement to meet the ergonomics:

- 1) displaying the campus on the map;
- 2) interaction with the University's website;
- 3) review the main sections and information that is more interesting to the user (for example, primarily news or events, and not always the welcome screen).

To meet the FURPS model and the standards specified in the current article, the development was carried out using patterns. The architecture of the entire mobile app is based on the MVP pattern [4, p. 154], which contributes to the app's supportability.

According to the issued technical task, the map display in the mobile app must use the YandexMaps API. During the development and implementation of the application, a single approach was available based on embedding the browser in the Fragment system object. Now you can use the Yandex MapKit embedded maps programming interface.

To use Mapkit, follow these steps:

- 1) get the developer key in the developer dashboard;
- 2) install the MapKit library;
- 3) configure its display.

The performance and the application response time were also increased. The comparison of interaction time with the map is shown in table 1.

Table 1. – Comparison of map loading

Connection type	Average download time, ms	
	before	after
WiFi	770	100
Mobile network	2690	259

The news interaction section has also been redesigned to increase the app's performance. The mobile app is not a self-sufficient software solution because it depends on information received from third-party sources. If you change the software interfaces of information source servers, you should also change the mobile app.

Changes were made to the news section of the University's website. Early in order to get news, the user had to spend time loading the last 100 news items. But now it is possible to load smaller sets with an arbitrary number of news items. Using the paginated display approach, performance was increased. A comparison of the feed loading time is shown in table 2.

Table 2. – Comparison of news feed loading time

Connection type	Average download time, ms	
	before	after
WiFi	8770	547
Mobile network	12690	1536

Interface ergonomics is optimized in accordance with the Google recommendations listed above, as well as user reviews in the PlayGoogle app store. According to the results of reviewing reviews, it was found that users did not want to view information about the educational institution in the first place. Because of this, the information screen will only be shown at first when the app is launched for the first time. The news feed will be shown next time. To make additional changes to the interface, a survey of students, applicants, and University employees is planned.

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**Аннотация.** Разработка программного обеспечения трудоёмкий процесс. Для того чтобы сохранить качество программного продукта следует придерживаться рекомендаций и стандартов. Для области разработки программного обеспечения существует собственный набор таких стандартов, которые могут быть оформлены в модели качества. Одним из самых популярных моделей качества являются модель МакКола и FURPS. Для мобильных приложений на операционной системе Android существует набор созданный компанией Google. В статье указан ряд решений при поддержке и оптимизации мобильного приложения с целью соответствия выбранной модели качества.

**Ключевые слова:** качество, стандарты, мобильное приложение, производительность программ, паттерн.

**Annotation.** Software development is a time consuming process. In order to maintain the quality of the software product, one should adhere to recommendations and standards. For the field of software development, there is a proprietary set of such standards that can be formalized in a quality model. Some of the most popular quality models are the McCall model and FURPS. For mobile applications on the Android operating system, there is a set created by Google.

The article indicates a number of solutions with the support and optimization of a mobile application in order to match the selected quality model.

**Key words:** quality, standards, mobile application, program performance, pattern.

**DEVELOPMENT OF SMART CLIMATE SYSTEM*****Denis Kardakov***

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**Introduction.** The microclimate of residential and working premises is the most important component of a healthy and productive rhythm of human life. We do not often think about how various environmental factors wag our body, while they can greatly affect the state of human health.

The aim of this work is to develop a smart microclimate system that is capable of measuring and evaluating the quality of the environment, as well as adjusting its condition to increase human comfort. In our work, we focus on global trends in digitalization and the creation of smart space.

**Materials and Methods.** Our device works by the following algorithm: collecting environmental state data, transferring this data to the server, processing and presenting it in the application, collecting feedback from the user, tuning environmental factors indicators based on the feedback of specific user, and adjusting the microclimate for these indicators to create conditions for maximum comfort and productivity of the user.

Data collection is carried out using sensors controlled by Arduino Mega2560 microcontroller. The prototype device includes followed sensors: temperature, humidity, CO<sub>2</sub> level, dust, light level and pressure [1, 3]. To transfer data over a Wi-Fi network, the ESP-01 board based on the ESP8266 chip is used. Also for the color indication of environmental state in the prototype LED strip is used. The schematic diagram is shown in Figure 1.

**Results.** To present information on a smartphone, an application was created (based on Blynk App), which processes the received data and displays it in the form of graphs and charts, and also informs the user about the excess of any of the environmental indicator [2]. The application screen is shown in Figure 2.

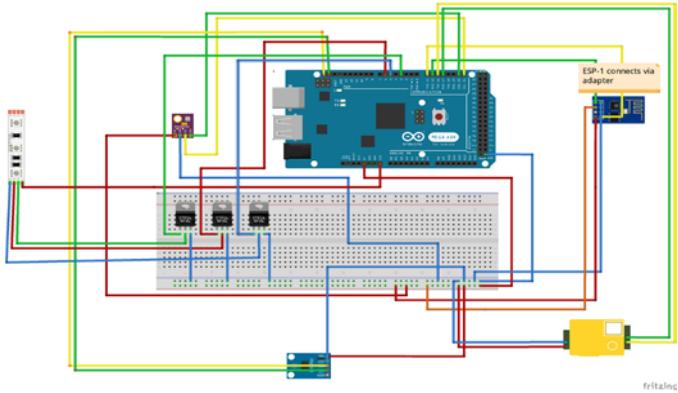


Fig.1 – Schematic diagram of device



Fig. 2 – Application screen

After that the app collects feedback from the user, and adjusts “comfortable” indicators to the new values according to the feedback. This step will be implemented based on neural network technology. The network that we’ll create, each time after receiving feedback, will retrain and synthesize new weight coefficients of “comfortable” indicators of environmental factors. The last step will be implemented by introducing our device into the ecosystem of a smart home, which will allow it to control devices that regulate the microclimate of the room (air conditioning, forced ventilation, etc.). At this stage, the prototype of the device looks like this (Figure 3).



Fig. 3 – Device prototype

**Discussions and Conclusions.** Due to the deterioration of the global climate on the planet, control of the personal microclimate is one of the priorities of modern human. The device created during the work will help people to control and maintain a comfortable environment in their homes or at work.

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**Аннотация.** В статье рассматривается разработка устройства, позволяющего отслеживать и контролировать различные факторы окружающей среды, которые влияют на здоровье и работоспособность человека. Был разобран принцип работы устройства, а также изучены основные возможности уже созданного прототипа. В заключении были рассмотрены возможности по усовершенствованию прибора и его применению в реальном мире.

**Ключевые слова:** микроклимат, здоровье, интернет вещей, умный дом, цифровизация.

**Annotation.** The article discusses the development of a device that allows you to track and control various environmental factors that affect

human health and performance. The principle of the device's operation was analyzed, and the main features of the created prototype were studied. In conclusion, the possibilities for improving the device and its use in the real world were considered.

**Keywords:** microclimate, health, internet of things, smart home, digitalization.

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## **DEVELOPMENT OF MANIPULATOR CONTROL SYSTEM**

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**Introduction.** Development of control systems for multi-link robotic manipulators is one of the most important sections of modern theory of automatic control. This is due to the high demand for such systems from industry. Manipulation robots, as a rule, are characterized by a higher cost in comparison with traditional devices, but due to flexible configurability they are able to perform a wide range of various tasks in an industrial manufacture, including those that previously could only be performed by humans [1].

The aim of this work is to develop a manipulator control system for its autonomous operation which could resolve various manufacturing problems (capture, moving, sorting objects).

**Materials and Methods.** The basis for the development is the Optima-2 robotic arm of the «Zarnitsa» company. This manipulator is based on Arduino, which allows you to freely “flash” it with your own control programs. In order to successfully control the manipulator, the following steps are required: calculate and build a mathematical model of capture, transfer it to a computer program for simulation, create a control channel for the real manipulator, come up with an interface for the interaction of the simulation and the real manipulator. Having completed all these steps, we will get a platform ideally suited for testing and developing an automated robot control system [2].

In order to create a manipulator model, you first need to build the Denavit – Hartenberg representation, which describes the rotational and translational connections between adjacent parts of the device. The Optima 2 manipulator has 5 degrees of freedom (5 links), therefore, the Denavit – Hartenberg representation will look like this (Figure 1).

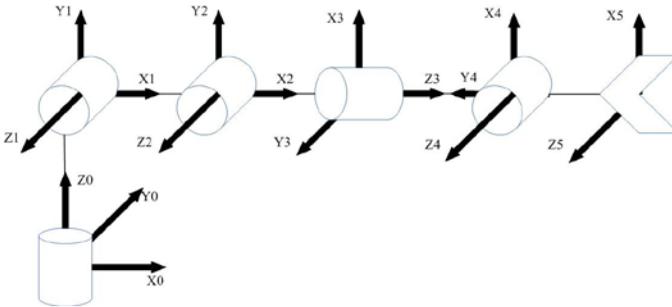


Fig. 1. – The kinematic diagram of the Optima 2 manipulator

Using the DH method, we have created a kinetic model of our manipulator. Now we can begin to solve the problems of direct and inverse kinematics, without which it is impossible to control the manipulator. The task of direct kinematics is to calculate the position of the working body of the manipulator according to its kinematic scheme and the given orientation of its links. The inverse problem is the calculation of angles for a given position of the working body and scheme of its kinematics.

Thus, the solution of the direct problem tells us - where will the working grip of the manipulator be located at given angles of its joints, and the inverse problem, on the contrary, says: how to “turn out” the manipulator so that its working body is in the given position.

To solve them, it is necessary to compose the transformation matrix of our model. The homogeneous transformation matrix can be divided into four submatrices:

$$T = \begin{bmatrix} R_{3 \times 3} & \vdots & p_{1 \times 3} \\ f_{1 \times 3} & \vdots & 1 \times 1 \end{bmatrix} = \begin{bmatrix} \text{Rotation} & \vdots & \text{Displacement} \\ \text{Perspective} & \vdots & \text{Scale} \end{bmatrix}$$

$R_{3 \times 3}$  – is the rotation matrix of the system  $x_n y_n z_n$  with respect to  $x_0 y_0 z_0$

$p_{1 \times 3}$  - vector of linear displacement of the origin of the coordinate system  $x_n y_n z_n$  relative to  $x_0 y_0 z_0$

$f_{1 \times 3}$  - a 1x3 sub-matrix defines the perspective transformation;

The fourth diagonal element is a global scaling factor

Additionally, to solve the IKP, it is necessary to take into account the working area of the manipulator. A work area is the set of all points in three-dimensional space that a grip can achieve. Knowing the boundaries of the robot shell allows you to judge the capabilities of the robot.

Now when we have successfully built a mathematical model of manipulator, we can proceed to the creation of the simulation. For this, the



Fig. 2. – Optima 2 manipulator

URDF model of the manipulator was assembled, which contains all the information we received when calculating the mat. models. It is required to build 3D simulations in programs such as Rviz and Gazebo. Next we will use Moveit, - program for generation and execution of motion paths of manipulator simulation. Now let's proceed to the control of a real robot. The Optima 2 manipulator is shown in Figure 2.

For the movement of the robot stepper motors and a servo drive are responsible. To manage them in the Arduino environment, AccelStepper

and Servo libraries were used. Having written the firmware to start the engines, we proceed to create an

interface for the interaction of the simulation and the real manipulator.

To implement the interaction, we will use ROS (Robot Operation System). The main idea of the interface was the following: move the manipulator in the simulation, and the real manipulator should reflect this movement in real time. To do this, a rosnode was created that converts the rotation (in degrees) of each joint on the simulated robot into the steps necessary to move the robot arm to the desired position. Then, to send the step data to Arduino, we wrote our own ROS message, which structured the step data. As a result, a rostopic (data transmission channel) was created in which, on the one hand, the simulation published data, and on the other hand, the Arduino read them. Thus, whenever a movement was performed in a simulation, it was reflected in a real robot.

**Results.** The main result is the development of an algorithm for creating a multi-link manipulator control system with almost any link configuration. Also, a platform for testing and developing an automated

control system for the Optima 2 manipulator was developed. This will expand the class of tasks that robot can solve, due to the possibility of its reprogramming.

**Discussions and Conclusions.** In the future, it is planned to add a camera for the implementation of finding and recognizing objects and moving them to a given point.

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**Аннотация:** В статье рассматривается разработка алгоритма создания системы управления для любого многосвязного манипулятора. На примере рассматриваются способы симуляции и управления роботом. В заключении были рассмотрены возможности по усовершенствованию прибора для применения для более широкого круга задач.

**Ключевые слова:** робот, манипулятор, ROS, Arduino, антропоморфный манипулятор

**Annotation:** This article discusses the development of an algorithm for creating a control system for any multi-link manipulator. Methods for simulating and controlling a robot were studied on example. In conclusion, the possibilities of improving the device for use in a wider range of tasks were considered.

**Keywords:** robot, manipulator, ROS, Arduino, anthropomorphic manipulator

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## **MICROWAVE HUMIDITY METER FOR PETROLEUM PRODUCTS**

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## 1. Introduction.

The analysis of methods and tools for measuring the humidity of petroleum products shows that direct methods for measuring the humidity of petroleum products are characterized by low productivity and high labor intensity of measurement, indirect methods of measurement based on determining the parameters of petroleum products functionally related to the humidity of these products have significant advantages over direct methods in terms of ease of implementation and measurement performance. Microwave methods based on measuring parameters of an electromagnetic wave passing through the object of study and reflected from it, the review shows that the scientific and technical literature, apply quite often because of ease of implementation and possibility of humidity control of oil flow. Phase and frequency measurement methods are used in the microwave range much less often due to the difficulties of implementing model phase shifters and other elements of the microwave path. On the basis of resonant methods which are highly sensitive to the humidity of petroleum products, a wide class of microwave measuring equipment has been created, and additional and detailed analysis of their advantages and disadvantages is required in order to select a technical solution that best meets modern requirements for metrological, technical and economic characteristics [1, 2].

## 2. Research of the open resonator method

Let's consider a method for measuring the humidity of petroleum products with an open resonator. It is known that for an open resonator when electromagnetic vibrations are excited in it, one can write the expression [3]

$$\omega_{\text{res}} = \frac{\pi qc}{2L}, \quad (1)$$

where  $c$  —the speed of an electromagnetic wave propagation in free space;

$L$  —the distance from one reflector to another;  $q$  is a constant ( $q \geq 3$ ).

In this variant, the reflectors of the open resonator are located opposite each other on the outer surface of dielectric pipe, therefore, in the expression (2) instead of  $L$  one needs to use the outer diameter of the tubing, but instead  $c$  the speed value of the wave during its propagation through dielectric tubing to the measured dielectric oil.

Taking it in mind, expression (2) will be:

$$\omega = \frac{\pi qc}{2D\sqrt{K}}, \quad (2)$$

where  $D$  —outer diameter of the pipeline  $K$  —parameter taking into account the effect of the dielectric properties of the pipeline and the measured water-emulsion flow on the wave propagation speed simultaneously.

In our version, the parameter  $K$  can be represented approximately as the sum of the pipeline permittivity  $\varepsilon_T$  and the watered oil product  $\varepsilon_H$ . It is obvious that  $\varepsilon_T$  depends on the pipeline material, so it can be considered constant during the measurement process. At the same time, at constant values  $\varepsilon_T$  and  $D$  the resonant frequency changing  $\omega$  will be determined by the value of the permittivity of the water-emulsion flow.

In this case, one can assume that the value of diffraction losses is close to zero. Then we can write for the deceleration coefficient

$$K = \varepsilon_T + \varepsilon_H (1 + 3 \cdot W), \quad (3)$$

where  $\varepsilon_T$  — relative permittivity of the pipeline material;  $\varepsilon_H$  — relative permittivity of petroleum product in the pipeline;  $W$  — oil product humidity.

On the basis of the above mentioned results and taking into account the known dependence of the dielectric permeability of the bypass flux (Wiener formula) of the content we can write a formula defining the relationship of the resonant frequency of an open resonator with a moisture content of oil in the flow [3]. We substitute the expression (3) for the deceleration coefficient for the resonant frequency  $\omega$  of an open resonator consisting of two reflectors located on diametrically opposite sides of the pipeline

$$\omega = \frac{\pi qc}{2D\sqrt{\varepsilon_T + \varepsilon_H(1 + 3 \cdot W)}}. \quad (4)$$

The solution of equation (4.2.4) regarding to  $W$  is an expression

$$W = \frac{(\pi qc)^2 - 4D^2(\varepsilon_T + \varepsilon_H)\omega^2}{12D^2\varepsilon_H\omega^2}. \quad (5)$$

Analysis of the last expression shows that at constant values of the dielectric permeability of oil product  $\varepsilon_H$ , and its outer diameter  $D$  at the resonant frequency of an open resonator formed by two reflectors, mounted

on the outer surface of dielectric pipe opposite each other, it is possible to estimate the value of moisture content of the oil product in the flow.

However, there is an error because of the inaccuracy of determining the resonant frequency of the open resonator due to the small slope of the frequency adjustment at the top of the resonant curve.

To reduce this error, one need to know another parameter related to the moisture content of the oil product. In accordance with this, it is advisable to create another equation.

For a wavelength in free space, we can write

$$\lambda = \frac{2\pi c}{\omega} .$$

On the other hand, it is known that the  $Q$  factor of this open resonator, taking into account the accepted notation, can be described by the expression

$$Q = \frac{D\omega\sqrt{K}}{\alpha c} , \quad (6)$$

where  $\alpha$  — the relative loss of energy when a single wave interacts with reflectors.

It is known from electrodynamics that the q-factor of a resonator can be determined by the ratio of the resonant frequency  $\omega$  to the width  $\Delta\omega$  of the resonant curve at the level of half power, i.e.

$$Q = \frac{\omega}{\Delta\omega} .$$

Then, we can write the following expression taking into account formula (3)

$$\Delta\omega^2 = \frac{\alpha^2 c^2}{D^2 [\varepsilon_T + \varepsilon_H (1 + 3W)]} . \quad (7)$$

Hence for the desired humidity we can get

$$W = \frac{\alpha^2 c^2 - D^2 (\varepsilon_T + \varepsilon_H) \Delta\omega^2}{3D^2 \varepsilon_H \Delta\omega} . \quad (8)$$

From expression (8), it can be concluded that the width of the resonance curve at the half-power level can be used to estimate the moisture content of petroleum products in the flow. Then, one need to determine from  $\varepsilon_H$  the formula (5)

$$\varepsilon_H = \frac{\pi^2 q^2 c^2}{4\omega^2 D^2 + 12\omega^2 D^2 W}. \quad (9)$$

Substituting formula (9) in expression (8) we can get the following expression for the humidity of petroleum products in the stream

$$W = \frac{\pi^2 q^2 c^2 \Delta\omega^2 - 4\alpha^2 c^2 \omega^2}{12\alpha^2 c^2 \omega^2 - 8\omega^2 \Delta\omega^2 \varepsilon_T D^2 - \pi^2 q^2 \Delta\omega^2}. \quad (10)$$

### 3. Conclusion

As a result of the research conducted in this section, the following conclusions can be made:

- analysis of the obtained expressions shows that by means of measuring the resonant frequency of an open resonator and the width of its resonant curve at the level of half power, it is possible to measure the moisture content of petroleum products;

- the measurement error  $W$ , depending on the deviation of the resonant frequency from its nominal value, does not exceed 1.26 %;

- the measurement error  $W$ , depending on the inaccuracy of determining the resonator bandwidth, does not exceed 1.2 %;

- measurement error  $W$  because of inaccuracy in determining the relative permittivity of the pipeline does not exceed 1.0 %;

- the resulting error in measuring the humidity of petroleum products due to the inaccuracy of determining the resonant frequency, resonator bandwidth, and pipeline permittivity does not exceed 2 %, which meets the requirements for equipment for measuring the humidity of petroleum products in conditions of continuous quality control.

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**Аннотация.** В работе дан анализ научно-технической литературы по вопросам разработки измерителей влажности нефтепродуктов трехсантиметрового диапазона. Цель разработки — повышение точности измерений. Осуществлен анализ возможностей измерителей влажности нефтепродуктов на основе резонаторного метода как наиболее чувствительного к информационным параметрам исследуемого материала. Предпочтение отдано открытому резонатору, позволяющему реализовать непрерывный контроль качества нефтепродуктов. Теоретической основой для разработки измерителя явилась формула Винера, устанавливающая связь диэлектрической проницаемости обводного потока с влагосодержания нефтепродукта.

Проведенный анализ основных составляющих погрешности измерения влажности нефтепродуктов показал: что погрешность за счет отклонения резонансной частоты от её номинального значения не превышает  $\pm 1,26$  %; за счет неточности определения полосы пропускания резонатора не превышает  $\pm 1,2$  %; за счет неточности определения относительной диэлектрической проницаемости трубопровода не превышает 1,0 %. При этом результирующая погрешность измерения за счет указанных причин не превышает  $\pm 2$  %, что удовлетворяет современным требованиям к аппаратуре контроля качества нефтепродуктов в условиях непрерывного контроля их качества на заключительном этапе производства..

Устройство предназначено для потокового контроля нефти в процессе её производства, в период транспортировки и хранения.

**Ключевые слова:** открытый резонатор, первый отражатель, второй отражатель, электромагнитная волна, диэлектрический трубопровод, резонансная частота, детекторная секция, коэффициент трансформации, невзаимный четырехполосник.

**Annotation.** This article analyzes the scientific and technical literature on the development of moisture meters for petroleum products in the three-centimeter range. The purpose of the development is to improve the accuracy of measurements. The analysis of the capabilities of oil products moisture meters based on the resonator method as the most sensitive to the information parameters of the material under study is carried out. Preference is given to an open resonator that allows continuous quality control of petroleum products. The theoretical basis for the development of the meter was the Wiener formula, which establishes the relationship

between the permittivity of the bypass flow and the moisture content of petroleum products.

The analysis of the main components of the error in measuring the humidity of petroleum products showed that the error due to the deviation of the resonant frequency from its nominal value does not exceed 1.26 %; due to the inaccuracy of determining the bandwidth of the resonator does not exceed 1.2 %; due to the inaccuracy of determining the relative permittivity of the pipeline does not exceed 1.0 %. At the same time, the resulting measurement error due to these reasons does not exceed 2%, which meets modern requirements for quality control equipment for petroleum products in conditions of continuous quality control at the final stage of production.

The device is designed for flow control of oil during its production, transportation and storage.

**Keywords:** open resonator, first reflector, second reflector, electromagnetic wave, dielectric pipeline, resonant frequency, detector section, transformation coefficient, non-reciprocal four-pole

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## **ALGORITHM FOR INCREASING THE CLARITY AND HIGHLIGHTING THE CONTOURS OF URINARY CONCRETIONS IN ENDOSCOPIC IMAGES**

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### **Introduction**

The development and widespread introduction of modern endoscopic research methods into clinical practice has significantly expanded the diagnostic and therapeutic capabilities in almost all areas of medicine. However, despite the constant improvement of endoscopes, their developers are currently facing an unsolved problem associated with a significant loss of image clarity during transurethral contact laser lithotripsy in the area of crushing urinary concretions. When the laser pulse is applied to the urinary stone, the laser radiation is absorbed by the stone, which leads to the formation of a microcrater on the surface of the stone and the evaporation of part of the substance, which is dispersed as an aerosol of solid and liquid particles [2]. Micro-explosion on the surface of the stone leads to turbulence of the physiological fluid surrounding the stone, which

makes the stone and the optical probe on the surgeon's monitor invisible. To avoid this negative effect, various image processing methods based on noise suppression could be used. Image correction performed during lithotripsy will increase the clarity of the stone contour and the optical probe and speed up the surgeon's establishment of contact between the distal end of the probe and the surface of the fragmented concretion, which will reduce the overall time of the operation [3]. In this regard, the task of improving the quality of the endoscopic image through its digital processing in real time is relevant.

### **Main part**

The purpose of this work is to develop an information system for processing video data from the endocamera. There is a problem with choosing the application implementation technology. Today, there are many different tools that can help solving this task, namely, capturing and processing a video stream. The most optimal option is the OpenCV computer vision and machine learning library [1], which has open source code and interfaces in various languages, including Python, Java, C++ and Matlab, which provides easy and fast portability to various platforms if necessary.

Reviewed endocam is [2] 1CCD HD ENDOCAM Performance HD. The analyzed video file obtained from it, which has a resolution of  $720 \times 576(1.25:1)$  at a frame rate of 50, is compressed by the AVC1 codec, the digital format \*.mp4 (\*.m4v) and is represented in the space YUV 4:2:0 (Y'cbcr). YCbCr can be easily converted to RGB for simple processing, as can reverse conversion.

The essence of the technology for increasing the clarity of the endoscopic image is that the input is fed a real-time video stream or a video file of a set format, processed in a loop, where the noise component is isolated when a shock is detected by a special function described below in the article. Then, in case of a positive reaction of the noise detector, frame-by-frame processing takes place: the image of the stone is saved to the buffer before it is exposed to laser radiation, then the original image is subtracted from the noisy frame (when it is detected) and the noise component is allocated. After this, the noise component is subtracted from the subsequent noisy frames, the relevance of which varies. The image is also post-filtered, which significantly improves its clarity. The algorithm is summarized in figure 1, peculiarities of the procedure of allocation of the noise are given below.

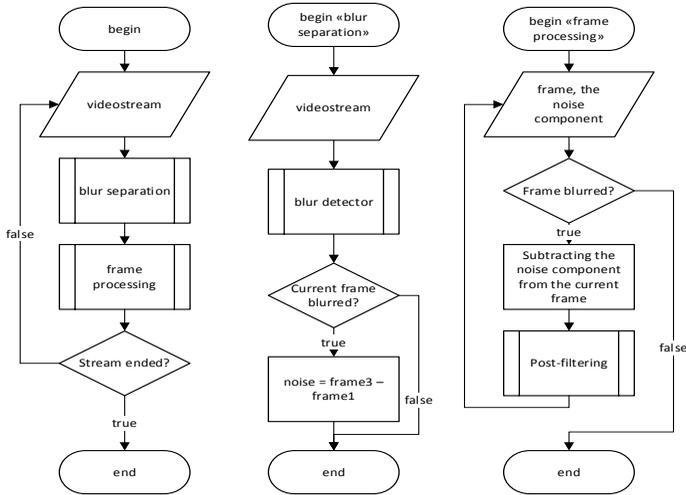


Figure 1-Video stream processing Algorithm for improving endoscopic images

In this work, attention is paid to the implementation of a noise detector for frames that appear when laser pulses are applied to the urinary stone. The optimal method for solving the problem is given in the article [5]. The essence of the method is as follows: to detect contour lines or focus images in many cases, it is advisable to use the Laplace operator (Laplacian), which calculates the second derivative of the function using the expression:

$$f_L(x,y) = 4f(x,y) - \{f(x,y+1) + f(x,y-1) + f(x+1,y) + f(x-1,y)\}$$

To do this, take one image channel (mostly grayscale) and collapse it with the next 3 x 3 core (the Laplace core):

$$H_1 = \begin{pmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{pmatrix}$$

Then the variance (i.e. the standard deviation squared) of the response is calculated.

This method is relatively simple and can be implemented with a single line of Python code:

```
cv2.Laplacian(image, cv2.CV_64F).var()
```

```
# Blur detection using OpenCV
# image parameter-analyzed image
# pre-conversion to grayscale is required
```

If the variance falls below a predetermined threshold, the image is considered blurred; otherwise, the image is not blurred.

The algorithm for implementing the considered method in a generalized form is shown in figure 2.

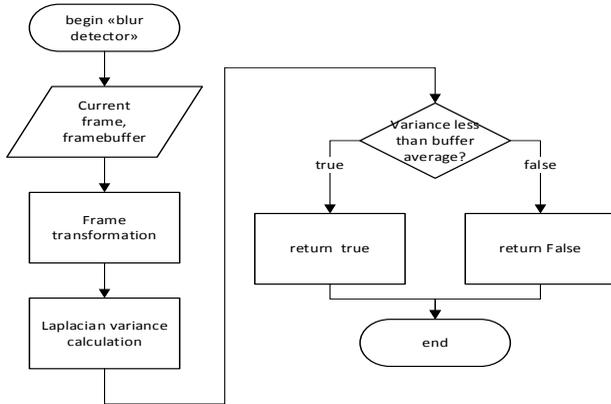


Figure 2-Noise detector Algorithm

The reason why this noise detection method works effectively is determination of the Laplace operator itself, which is used to measure the 2nd derivative of the image. The Laplacian highlights areas of the image that contain rapid changes in intensity. Accordingly, the Laplacian is often used for boundary detection. The assumption here is that if the image contains high dispersion, then there is a wide spread of results, both boundary and non-boundary, representative of a normal image in focus. But if we have a low dispersion, which corresponds to small response values, this indicates that there are very few borders in the image. As known, the more blurred the image, the fewer borders it has.

Obviously, another challenge here is to set the correct threshold, which can be quite dependent on a particular set of images. If the threshold is too low, the image is mistakenly classified as blurry, while it is not. Too high a threshold will lead to the fact that the images are actually blurred, not will be marked as blurred [4].

Thus, the video frame, as well as the buffer of the set of previous frames, is received at the input of the noise detector module. Then, after grayscale pre-conversion, the Laplace operator is applied to the current frame

and its variance is taken. As the image processing algorithm based on this method works best in environments where it is possible to calculate an acceptable range of focus measurement and then detect outliers, it was decided to average the numerical value of the detector for several frames. Therefore, the Laplacian variance is calculated the same way for frames from the buffer, and if its value for the current frame is significantly lower than the average for the buffer, the function considers it as blurred. This mechanism will help distinguishing the frame at the moment of laser impact on the stone from a set of frames that have low clarity due to the characteristics of the environment where endocamera is located.

Then, based on the result obtained from this module, the noise component is selected and then excluded from the number of frames, according to the main algorithm, or the transition to the next frame.

In the course of research, a software implementation of the described algorithm for removing turbidity from the video stream in real time has been developed. The developed technique, based on digital filtering of the endoscopic image, will allow the doctor to conduct the procedure not wasting time by waiting for the appearance of the contours of the stone and the probe in the image and continue crushing the urinary concretion. This will reduce the duration of additional manipulations when performing laser lithotripsy and reduce the duration of the entire operation, which will help reduce postoperative complications.

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**Аннотация:** В статье рассматриваются вопросы улучшения четкости эндоскопических изображений области воздействия лазерных импульсов на мочевые конкременты при проведении операции трансуретральной контактной лазерной литотрипсии с помощью гольмиевого лазера. Показано, что путем выделения шумовой компоненты эндоскопического изображения и вычитания ее из зашумленного изображения возможно существенное повышение четкости эндоскопического изображения и снижения вследствие этого времени проведения операции.

**Ключевые слова:** лазерная контактная трансуретральная литотрипсия, эндоскопические изображения, повышение четкости.

**Annotation:** In article is examine the issues of improving the clarity of endoscopic images in the area of laser pulse effect on urinary stones during transurethral laser lithotripsy operation with the help of a holmium laser. It is shown that by extracting the noise component of the endoscopic image and subtracting it from the noisy image, it is possible to significantly increase the clarity of the endoscopic image and thereby reduce the operation time.

**Keywords:** laser contact transurethral lithotripsy, endoscopic images, increased clarity.

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## **RESEARCH OF METHODS OF INTELLECTUALIZATION OF INTERACTION WITH USERS OF SHOPPING PLACES FOR OPTIMIZATION OF A SALES SYSTEM**

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### **Introduction**

Comments and evaluations of goods is an important part of communication between users of trading floors. But there is a problem of the adequacy of the ratings provided on the trading floor of goods or services, because of this, difficulties may arise both for sellers who may unfairly

receive poor ratings for their goods, and for buyers who will encounter artificially high ratings.

This article discusses one of the options for creating a system for generating ratings based on the context of the comment, based on solving the problems of recognizing a natural language and processing user comments.

### **Main part**

To solve this problem, it was decided to create a model based on LSTM – neural networks with long short-term memory [4]. This decision was made on the basis that this type of network is able to learn long-term dependencies, which is necessary when working with text. After all, the text does not imply a separate set of words, but the construction of chains fastened with a semantic connection [2].

To accomplish the task of analyzing the sentiment of comments, the corpus of Russian-language texts by Yu. V. Rubtsova was used [1], based on reviews left by users of the twitter network.

Next, the structure of a recursive neural network was determined. It was experimentally revealed that the most optimal option is a network with four layers, such as:

- the first layer is a Keras-embedding layer.
- the processed data is fed to the second layer of the network - a bi-direct LSTM with 256 outputs. The output of this layer also adds 2 columns of previously obtained meta information, presented in the form of previously defined numerical inputs.
- a fully connected layer, which includes 16 neurons with non-linear ReLU.
- fully connected output layer with sigmoidal activation function.

Before learning the neural network, stop words were removed from the corpus of words of Yu. V. Rubtsova, all tokens were reduced to a common lower case, and a normalization method known as “stemming” was used [1]. At the final stage of pre-processing, each word was assigned a unique serial number and a frequency response was calculated for each of them. The results are presented in the form: “unique word” and “amount of use of this word in a specific text” [3].

It was decided to use six eras for training, since this value allowed us to achieve the greatest accuracy at the testing stage, provided that we use the average available characteristics of the GPU. In this study, we used the Nvidia Geforce GTX 1050 graphics card with 4 gigabytes GDDR5.

In order to evaluate the model without being tied to a specific threshold, the ROC-AUC metric is used. The accuracy obtained during testing is 0.9980, which means almost complete absence of errors. It should also be noted that this model allows you to split comments into any desired number

of classes, provided that a training array of training data with appropriate markup is found.

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**Аннотация.** В статье рассматривается задача анализа и классификации комментариев посредством использования нейронной сети LSTM на примере анализа тональности комментариев пользователей торговых площадок. Описаны методы, применяемые при разработке модели, описан процесс ее проектирования и обучения при средних характеристиках ПК. В заключении указана точность, полученная при тестировании модели, а также возможности и указания по ее модификации.

**Ключевые слова:** обработка естественного языка, искусственные нейронные сети, анализ тональности комментариев, LSTM, TF – IDF.

**Annotation.** The article considers the task of analyzing and classifying comments by using the LSTM neural network using an example of the analysis of the tonality of comments by users of trading floors. The methods used in the development of the model are described, the process of its design and training with average PC characteristics is described. In conclusion, the accuracy obtained during testing of the model is indicated, as well as the capabilities and instructions for its modification.

**Keywords:** natural language processing, artificial neural networks, analysis of the numerical value of comments, LSTM, TF - IDF.

**WORK PLACE MONITORING FOR OFFICE WORKERS  
WITH SEDENTARY NATURE OF THE ACTIVITY**

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Cervicobrachial and carpal pains are a common problem, especially among the working population. In the European Union, in the 2000s, 23% of the working population reported working-related neck or shoulders pain, and in 2015 this figure reached 41%. The percentage of complaints about work-related muscle pain in the upper extremities ranged from 13% to 20% and from 58% to 60% in different periods of the 2000s and 2015, respectively [15] with a working-age population of 65.8% (487 million people).

In addition to sick leave and chronic disability, neck-shoulder and carpal pain can also lead to a decrease in work efficiency. Many workers continue to go to work, despite feeling bad, when they should have taken sick leave. This phenomenon is known as presentism [3]. Although they are present at work, their productivity may be reduced due to functional limitations. The extent of performance loss in this case is uncertain, but it has been suggested that this accounts for most of the performance loss associated with chronic pain [14].

In the Russian Federation, despite chronic ailments, more than 75% of employees do not take sick leave. Among the most common reasons why Russians do not take "sick leave" are: fear of losing a job, no one to replace and do work, a big loss in wages [1]. The data of the Social Insurance Fund suggests that the situation worsens every year. So, if in 2016 40.5 million sick leaves were issued, then in 2017 there are already about 40 million sheets issued in paper or electronic form [2].

Due to the lack of official documents provided by employees about the illness, the employer may not have an idea about the poor health of employees. As a result, the drop in labor productivity is not associated with the well-being of employees.

Both before and after a period of illness, a decrease in productivity may occur. Brower et al. [4] found that among employees of a trading company, 25% of respondents experienced a loss of productivity before illness, and 20% felt such a loss after it. The decrease in productivity after sick leave due to disorders of the musculoskeletal system among workers was also studied by Lötters et al. [12]. They found an average loss of 1.6 hours over an 8-hour work day among workers with reduced productivity.

Decreased productivity increases employer indirect costs. In a study of about 29,000 employees, health-related losses cost employers \$1,685 per person per year. Of these, 71% can be explained by a decrease in labor productivity [13]. Researchers found that the cost of lowering productivity was higher than the medical cost of certain health problems, such as allergies, arthritis, depression, and hypertension. Collins et al. [6] found that the costs associated with a decrease in productivity caused by various diseases, including neck or back diseases, significantly exceeded the total costs of sick pay and actual treatment. In a Swedish study by Hagberg et al. [8], the authors estimated that problems with the musculoskeletal system were associated with a latent loss of productivity costing \$504 per person per year in a company with 50 employees.

A study by office workers in Thailand found that over the course of the year, the prevalence of pain in the neck, lower back, upper back, wrists / hands and shoulders was 42.0%, 34.0%, 28.0%, 20.0% and 16.0%, respectively [9]. In another report, the annual prevalence of shoulder pain among office staff at HonKaen University was 63.1%, and the annual incidence of lower back pain in the same group was 83% [5].

With these facts in mind, it makes sense to create a software product for monitoring and comprehensive assessment of the state of a person who, by the nature of activity, spends a lot of time in a sitting position, through pattern recognition and correction of his body position by providing him with recommendations.

Existing solutions on the market use various kinds of sensors and patches to recognize body position and stimulate posture changes. However, this is where the main disadvantages of such systems are manifested - the complexity of development and implementation, inconvenience in use for the end user, and the impact on the purity of experiments. The proposed solution is using a camera, which can be installed both in front of a person and from other angles, to obtain an image of a person and a neural network for pattern recognition.

Installing the camera in front of a person is the most affordable solution for the end user, since most laptops and some monitors already have a camera built-in, which simplifies and reduces the cost of using the

system. Installing cameras from a different angle will allow us to get a more complete picture and thereby to identify more factors and risks.

The image from the camera is frame-by-frame processed by the neural network to determine and classify the human posture, which subsequently, combined with other factors, is used as input to subsequent neural analysis networks, and statistics are stored for future use. Initial processing to isolate features occurs directly on the user's device, which allows to limit the amount of data transferred, as well as to maintain the desired level of privacy, since the image from the camera does not leave the user's device. A detailed analysis of the factors takes place on the server, minimizing impact on the user's computing power thereby, not interfering with everyday tasks.

As the output, the user receives statistics of the poses held by him with a schedule of their changes and parameters, recommendations for correcting the position of the body and monitoring progress. Long-term analysis and collection of statistics will allow us to build a reliable picture of the user's posture.

A study of university office employees assessed ergonomic risks that can stimulate the development of musculoskeletal disorders (MSDs) through observation with an Express Assessment of Office Workloads (EAOW) [11]. However, to assess the risks associated with the development of these violations, three main approaches were used:

1. Observation methods (the ways in which an observer can evaluate and record workplace behavior that is expected to increase the risk of irregularities);
2. Self-reports of employees (for example, the use of data obtained from interviews and questionnaires);
3. Direct measurements (for example, the use of monitoring tools that rely on sensors attached directly to the subject to measure exposure variables at work or the use of medical measurement tools) [7].

Kee D., Lee I. [10] studied the ergonomic risk associated with the development of MSDs. They examined the relationship between self-esteem of discomfort (subjective assessment) and direct measurement of postural load (objective assessment) and found a positive relationship between the two approaches.

To adequately assess the effectiveness of the system, an experiment should be conducted. It consists in introducing the system into the daily work at the computer of people divided into two groups. In the first group, the system only "monitors" the position of the human body and collects statistical data. For the second group, the system offers recommendations for adjusting the position of the body. As a result, it is assumed that the second group will be less prone to cervicobrachial and carpal pain, as

shown by statistical data and the results of the questionnaire survey. Such a result will prove the feasibility of both using the system for an individual user and introducing the system in a company.

There is a patent for the invention (US7613324B2), which involves comparing the reference value of posture with the changes. This and other similar patents use a preset of the reference value of posture and further comparison of each frame with it. In the described system, a trained neural network is used, which detects all positions that are not within the norm and notifies the user about it, and also adapts to the characteristics of each end user.

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**Аннотация:** рассмотрена проблема возникновения болей в шейно-плечевом поясе и запястьях, их влияние на продуктивность и трудоспособность, поставлена задача разработки программного комплекса мониторинга и анализа положения тела при малоподвижном характере деятельности, предлагается провести эксперимент для оценки достоверности получаемой системы

**Ключевые слова:** мониторинг, опорно-двигательный аппарат, шейные боли, плечевые боли, запястные боли, презентизм, искусственный интеллект

**Summary:** the problem of the occurrence of pain in the cervical-shoulder girdle and wrists, their effect on productivity and ability to work is addressed, the task of developing a software package for monitoring and analysis of body position with a sedentary nature of activity is set, the experiment is proposed to evaluate the reliability of the resulting system

**Keywords:** monitoring, musculoskeletal system, neck pains, shoulder pains, carpal pains, presentism, artificial intelligence

**METHODS FOR GENERATING RECOMMENDATIONS ON  
ELECTRONIC AUCTION SITES**

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There are various systems that contain platforms for electronic trading. Each platform can present different scenarios for making a deal. The sites have a different federal law, according to which they provide functionality for interaction, there can also be different depth of detail.

Basically, transactions of a purchasing nature occur in accordance with federal law No. 44 or federal law No. 223. Also, an individual customer may have own separate platform. Electronic platforms may differ in the type of transactions conducted. Auctions and purchases can occur on different platforms. Suppliers can move from one site to another. The supplier can use only one platform. They research existing order announcements and submit applications for them. Or they publish purchases from a single supplier.

In such a system, a recommendation subsystem is definitely needed, which will allow the supplier to receive procurement recommendations directly in personal account. And thanks to the existing system of joint display of purchases, he/she will be able to switch to them if necessary. It is assumed that such interest would arise with a high degree of probability. Because the recommendation is made taking into account the history of user actions, which are weighed and analyzed.

As a rule, each announcement is connected with a generally accepted reference book, for example, “All-Russian Classifier of Products”, “All-Russian Classifier of Types of Economic Activities” and others. In such a situation, the supplier is tied to one or more items from the directory. An automatic cataloging system would be suited to solve this problem well. But, not at all sites, binding to such directories is provided, and then the analysis becomes more complicated. A system is created that collects all text data, consisting of a history of the user's actions and his/her published ads, and determines what interests the user. By analyzing the resulting text data sets, a matrix of their similarity is created. Next, a method for determining the similarity threshold is formed, according to which a recommendation is formed.

For this analysis it is possible to use:

1) Methods for preparing text data sets [1]:

- Removal of emoticons;
- Removal of stopwords;
- Stemming;
- Word vectorization.

2) Machine learning methods [2]:

- Nearest neighbor method;
- Naive Bayes;
- Softmax;
- Support vector machines.

To obtain the most effective implementation of the recommender system, it is required to study data sets from the electronic bidding system, and to select suitable training methods for linguistic analysis. For example, the use of stemming or lemmatization is possible [3]. However, lemmatization will have higher requirements for the equipment to be performed, and may take longer to calculate. Depending on the amount of data, this operation may lose relevance due to the impossibility of implementation. It is possible to use parallelization, but this may not help. And first of all, the main goal is to get the best result.

After that, it is required to study suitable machine learning methods and select criteria for comparison on the basis of which a choice will be made.

Obviously, the use of neural networks like multilayer perceptron is redundant here. It is possible to consider the use of recurrent neural networks, as they are well suited for word processing. Metric and probabilistic classifiers should also be considered.

Depending on the combination of linguistic analysis methods, the learning outcome of each method may be superior to the other.

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**Аннотация.** Существует большое множество рекомендательных систем. Реализация каждой из них подстраивается под свою конкретную

систему. В таких системах используются различные методы расчета рекомендаций. После выбора наиболее подходящего типа рекомендательной системы, решается задача выбора лучшего алгоритма формирования рекомендаций, которая заключается в определении эффективных методов подготовки данных и методов обучения системы. Результатом сравнения должна стать рекомендация по использованию одной или нескольких комбинаций этих методов. В рамках доклада происходит рассмотрение подходящих для системы рекомендаций методов машинного обучения, которые подходят для электронных торгов в большей степени. Вводится понятие актуальности рекомендаций и их роли на площадках электронных торгов. В докладе рассматриваются методы предобработки объявлений об электронных торгах и возможные системы обучения для их классификации.

**Ключевые слова:** рекомендательная система, предобработка текста, машинное обучение, анализ алгоритмов.

**Annotation.** There is a great variety of Recommender systems. The implementation of each of them is adjusted to its specific system. These systems use different methods for calculating recommendations. After selecting the most appropriate type of recommendation system, the problem of choosing the best algorithm for generating recommendations is solved, which consists in determining effective methods of data preparation and methods of training the system. The result of the comparison should be a recommendation for using one or more combinations of these methods. Machine learning methods suitable for e-Commerce to a greater extent are considered as available ones for the recommendation system. The concept of relevance of recommendations and their role on electronic trading platforms is introduced. The report discusses methods for pre-processing e-auction ads and possible training systems for classifying them.

**Keywords:** recommendation system, text preprocessing, machine learning, algorithm analysis.

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## **THE ROLE OF SOCIAL NETWORKS IN THE EDUCATIONAL PROCESS**

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It is difficult to imagine a modern person without the information technologies that fill his life, they permeate all areas of activity, and education is no exception. Today you will not surprise anyone with such words as “distance learning”, “unified educational information environment” and “open educational resources”. The educational system is faced with the task of helping the teaching staff not only to effectively move from the age of “blackboard and chalk” to the age of “electronic education”, but also to show the teacher how to be closer to students, making maximum use of all the opportunities provided to us by the Internet in the educational process. Over the past few years, the world pedagogical community has been discussing the possibility of using social networks in education. Social networks contribute to the development of e-learning and education in general, offering new technical and methodological solutions [3]. The modern period of development of school education is characterized by the active and comprehensive implementation of information and communication technologies in it, which can significantly change the content, methods and forms of education. The main goal of their implementation is the development of students' intellectual abilities in the modern information society, as well as improving the quality of training and education. Socio-political, economic and socio-cultural changes taking place in Russia in the last decade have led to the need to update the education system, its focus on entering the global educational space. In accordance with this, Russian education should have a focus on preparing students not only to adapt to modern society, but also be competitive in the labor market, ready for further life in the global society, a single information educational space. The new educational standards set the main task in creating a new style of thinking, thanks to which the student will be able to study independently, set educational goals and find ways to solve them, using all the tools of information technology.

Annual studies demonstrate a significant differentiation in the popularity of social networks depending on age, gender, life interests of users and many other factors. This is quite reasonable, given the initial purpose of various social networks: for the general public, for students to communicate, for specialists in various fields of activity. In addition, the difference in the social networks used is also geographical. On the Russian market of the Internet industry of social networks with long-term constancy, «ВКонтакте» and «Одноклассники» retain leadership. According to an audience survey, 39% and 32%, respectively, of those surveyed said they have accounts on these social networks and use them. The global social giant Facebook today in our country is the third most popular [8]. While all over the world (with

the exception of certain countries where the Internet space is limited by national resources), it has been a confident leader almost from the very beginning. Followed by social networks such as "Google+", "Instagram" and "Twitter". Moreover, between the last two there is serious competition for the audience, which provokes them to move away from the original ideas and principles. The remaining well-known social networks hold about the same percentage of the audience, but not comparable to the above. In addition, do not lose sight of thematic and professional social networks.

In connection with the emergence of a large number of new social services and networks, wide opportunities open up for teachers and students to use them in the educational process. These web services and networks are gradually becoming the socio-informational environment within which many pedagogical tasks of new education standards can be solved, requiring the use of radically new teaching methods and forms [1, p. 1056]. The space of social networks today is very actively explored by students of different ages. However, their main purpose is entertaining. Therefore, in order to turn the familiar space into an environment for self-education, you need a teacher who is assigned the role of coordinator or tutor [4, 7].

At present, our life is hard to imagine without the Internet, without information, it has covered the whole world and all spheres of our life. Almost every person on Earth now has the opportunity to access the resources of the global network. The strong development of web technologies and their impact on modern society has led to a change in the traditional areas of communication, a change in the ways and forms of communication on the Internet. The Internet has become a platform for barrier-free transmission and exchange of information, knowledge and communication between people of different cities and countries.

“A social network is a platform, online service or website designed to build, reflect and organize social relationships, the visualization of which are social graphs” [6].

In the usual sense, a social network is a community of people connected by common interests, a common cause or having other reasons for communicating with each other.

On the Internet, a social network is a software service, a platform for interaction between people in a group or in groups. In relation to the Internet, this is a virtual network, which is a means of providing services related to the establishment of connections between its users, as well as different users and their respective information resources installed on the sites of the global network.

Rapid progress and constant updating in the field of information technology makes it possible to use the capabilities of Internet technology as

an effective means of learning. When using the global Internet network, the formation of an information-educational environment takes place, which allows to fully implement modern training technologies. In these conditions, the topic of using social networks as a pedagogical tool becomes extremely relevant.

Social networks differ from each other in their common focus, different capabilities for users, different requirements and interface. However, there are common features inherent in many social networks and distinguishing them from other means of network communication, such as blogs, forums, chats and guest books. In some social networks, for example, blogs and forums are built into MySpace, however in this case we will only consider the features of the social network. Understanding these specific features is important in identifying opportunities for using social networks as an educational tool.

Today, in the modern theory of distance learning, there are various models of distance learning, such as the integration of full-time and distance learning; network training (stand-alone network courses; information and subject medium); network training and case technologies, distance learning based on interactive television or computer video conferencing.

In recent years, the issues of using social networks in education have been heatedly discussed in the world pedagogical community. Many methodologists are skeptical about the possibility of using networks as a pedagogical means of learning, since traditionally social networks are considered as an environment for spending free time and entertainment. Definitely, social networks may not be the only means of network learning, but their educational opportunities are clearly underestimated by them. Interest in social networks is associated with the need for educational institutions to establish direct effective communication with participants in the educational process and consumers of educational services. The network community will serve as an additional “informal bridge” between the teacher, student, future student (schoolchild) and the employer. In our opinion, with a serious and competent approach to the organization of educational activities through social networks, the initial negative of critics will be removed, and efforts will be rewarded.

The choice of social networks as a platform for organizing distance-interactive learning has a number of arguments. The principles of building many social networks, such as identification, communication, presence on the site, relationships, groups, reputation, exchange, search, integration with other offers are very suitable for creating a study group, class in the online space, in a social network. The placement of an educational resource on the basis of social networks automatically establishes direct effective

communication between the teacher and student, between student and student.

The analysis of the literature [5, 7-11] made it possible to highlight the main possibilities of using social networks in the process of training and education.

1. Organization of individual, collective and group work of students. The combination of group and individual forms of work contributes to a better assimilation and understand the educational material. The advantage of using social networks is that there is the possibility of a collective assessment of the results and work processes. An indisputable fact is that using social networks you can build an individual educational route for a student and use it as a space for organizing distance learning.

2. Organization of educational and extracurricular activities. The possibility of holding various contests, presentations, videos using social services and networks can help the class teacher in his work, if you use them as an information environment in which information about various events will be posted.

3. Exchange of resources and information. Social networks allow you to save, publish and share information to all participants in the educational process. When creating content for students it is worth remembering one simple rule - all additional useful material should be sought and added primarily by the student himself. Independent search activity will contribute to the intensification of cognitive activity. In addition, self-acquired knowledge is the most durable knowledge [2, p. 17].

4. The possibility of continuing education and self-education. The continuity of the educational process is understood as a continuous interaction between participants at any suitable time. In addition, it is possible to advise on homework or provide information support to those students who missed classes [12].

5. Organization of interaction between participants. Social networks are becoming an effective communication tool for participants in the educational process, both inside and outside educational institutions. With their help, it is possible to always stay in touch with students and their parents. An alternative to holding a parent's meeting or classroom may be conducting a thematic "dialogue", creating a group or public page on social networks or using social services.

6. The ability to create a portfolio of personal achievements of students. Portfolio is a way of recording, accumulating and evaluating individual achievements of students. Using social networks to create an electronic portfolio allows you to present many results and achievements of a student in a bright, interactive, accessible and understandable form.

7. Creation of school, city and regional communities to improve the quality and effectiveness of training. Social networks provide ample opportunity to maintain relations between participants in various seminars, competitions, conferences, exchange of ideas and opinions [5, p. 405-407].

The following advantages of using a social network over other types of network technologies can be distinguished.

1. A familiar environment for students.

The interface, methods of communication and publication of content in this environment by users are thoroughly studied. This is facilitated by high-quality convenience and understandability of the system, as well as an active and long-term experience in use.

2. A variety of forms of communication.

Wikipages, forums, polls, comments, subscriptions, sending personal messages and more provide ample opportunities for collaboration.

3. Unambiguous user identification.

Most often, in a social network, a person acts under his first name and surname, less often under a pseudonym. In other Internet services, the opposite is true.

4. The activity of participants is tracked through the news feed.

This tool allows the user not to get confused in the variety of information flows and to effectively monitor updates of various content. Students have the opportunity to keep abreast of all changes occurring in the learning process, to monitor the educational activity of classmates and the teacher, who, in turn, oversees and coordinates the work of students.

As problematic issues when using social networks in the educational process, it should be noted:

1. A high degree of labor costs for the organization and support of the educational process in the conditions of lifelong learning for the teacher;

2. The frequent lack of open access to social networks from the classrooms of schools and universities;

3. The presence in the space of a social network of factors distracting from educational activities (active communication, rapid information flow and an abundance of entertainment content);

4. Lack of convenient tools for organizing and managing the educational process;

5. openness of the educational process to the entire Internet community, which for many teachers is unacceptable or uncomfortable;

6. The impossibility of assessing the work of teachers on the existing universal criteria for paying for his work.

The solution of the identified problems is possible through a deeper study of the educational opportunities of social networks, the development

and testing of effective methods for their application in the educational space, the development of specialized applications for social networks. Naturally, in order for social networks to become a full-fledged educational environment, it is necessary to overcome many difficulties and problems of various kinds, the common efforts of information technology specialists and teachers are needed.

As for Kazakhstan and the CIS countries, here this tool is just beginning to be mastered. He did not receive widespread recognition; this is still far enough away. So far, good examples are few. Particular attention is paid to the aspect of using social networks for educational purposes.

Today, universities must use various education management systems. With their help, universities will be competitive and will provide students with an interactive, mobile and engaging environment that is relevant to global market trends in training and communication.

All these trends in the development of social networks create a situation where the inclusiveness of the audience and the simultaneous use of the maximum number of opportunities provided by modern Internet technologies transfer educational activity to a completely different, significantly higher level. Social networks are not just an opportunity to communicate, it is an important educational tool for schools and universities.

Summarizing all of the above, we can conclude that the use of social networks in the educational process can stimulate the development of creative abilities, cognitive interest of students, as well as increase motivation for learning activities. We believe that the introduction of social networks in the educational process will expand the unified information space of the school, create open and accessible educational resources for students, and create a new information culture of thinking of participants in the educational process.

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Moscow Pedagogical State University. Pp. 328-332. [URL: <http://rrpedagogy.ru/journal/article/1208/>].

**Аннотация.** Актуальность проблемы исследования обусловлена активными процессами информатизации общества и образования, которые изменили парадигму современного образования. Проблема исследования заключается в том, что в связи с появлением большого количества новых социальных сервисов и сетей учителя и учащиеся имеют большие возможности использовать их в учебном процессе, но учителя и школьники не всегда умеют правильно ими пользоваться. В статье представлен анализ направлений использования в образовательной и внеучебной деятельности социальных служб и интернет-сетей. Были использованы следующие теоретические методы: теоретико-методологический и научно-теоретический анализ литературы по исследуемой проблеме. В результате выявлены основные возможности использования социальных сетей в процессе обучения и воспитания, даны конкретные рекомендации преподавателям и студентам по их использованию. В результате был сделан следующий вывод о том, что использование социальных сетей в учебном процессе может стимулировать развитие творческих способностей учащихся, их познавательный интерес, а также повысить мотивацию к учебной деятельности.

**Ключевые слова:** социальные сети, педагогическое сообщество, информационное общество, образовательный ресурс, методические решения, коммуникационные технологии, дистанционное обучение.

**Annotation.** The relevance of the research problem is due to the active processes of informatization of society and education, which have changed the paradigm of modern education. The research problem is that due to the emergence of a large number of new social services and networks, teachers and students have great opportunities to use them in the educational process, but teachers and schoolchildren are not always able to use them correctly. The article presents an analysis of the areas of use in educational and extracurricular activities of social services and Internet networks. The following theoretical methods were used: theoretical-methodological and scientific-theoretical analysis of the literature on the problem under study. As a result, the main possibilities of using social networks in the process of training and education are revealed, specific recommendations for teachers and students on their use are given. As a result, the following conclusion was made that the use of social networks in the educational process can stimulate the development of students' creative abilities, their cognitive interest, as well as increase motivation for learning activities.

**Keywords:** social networks, pedagogical community, information society, educational resource, methodological solutions, communication technologies, distance learning.

UDC 004.912

## **AN OVERVIEW OF TEXT SIMILARITY MEASURES FOR CONTENT-BASED RECOMMENDER SYSTEM**

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The development of electronic trading platforms and the tendency to transfer business to the online served as an impetus for the development of recommendation systems. The profit of such companies mainly began to depend on the number of sales made through their Internet platform, so to maximize it, many companies began to look for ways to make using their product more convenient to attract more customers. Recommender systems allow you to choose the products that would be most interesting to the user, based, for example, on his preferences and purchase history. Their use facilitates the user's work with the Internet resource and at the same time is the very tool that helps the company achieve its economic goals.

In this case, we consider a recommendation system for the electronic government trading platform, built on product descriptions. Its essence lies in the search for products which have similar description to those that the user has already bought. The central part of such system is the calculation of the similarity of the two descriptions. Thus, this article discusses the main measures used to determine the similarity of texts.

The description of the goods presents a text with certain terms that clearly characterize the category of trading item. Therefore, to search for similar products, it is logical to use methods based on processing of terms.

Similarity of terms is a concept used to check the similarity of two documents by measuring the similarity of their terms. Other measures may include the length of the document, the number of general terms, ordinary or unusual terms, the number of occurrences of the term [1].

Before applying machine learning methods to the text and calculating measures of similarity of terms, descriptions and the words contained in them must be converted to a numerical representation. The first step is to create a

dictionary of unique words. The dictionary is used to build a multidimensional space in which each document is converted into a term frequency vector (TF) by counting the occurrence of terms (words) in the text. In addition to the frequency of terms, it is also necessary to quantify the information content that a particular term carries. The inverse document frequency (IDF) is used for this. The combination of both measures gives a well-established measure (TF-IDF) which weigh terms highly that have a high information content due to their rarity. This measure is most often used in tasks related to processing of documents, including the search for similar texts [6].

The next step after vectorizing the text is to calculate the similarity of terms. In general, words can be similar in two senses: lexically and semantically. Words are similar lexically if they have the same sequence of characters. If words have the same theme, then they are semantically similar.

The similarity measure determines how close or distant the request document vector is from the document in the corpus; and choosing the appropriate measure of similarity is central to designing an effective and efficient recommender system.

The similarity between the texts can be divided into three categories: string-based, corpus-based, and knowledge-based. String algorithms are used to measure lexical similarity; algorithms based on corpus or knowledge are used to determine semantic similarity [5].

In this case, only terms-based similarity measures are considered. Among them, we can highlight some commonly used measures:

1. Manhattan distance. It is used to calculate the distance that will be traveled from one data point to another along a grid path. In an n-dimensional real vector space with a fixed Cartesian coordinate system, the distance between the vectors  $p$ ,  $q$  is the sum of the lengths of the projections of the line segment between points on the coordinate axis.

2. Dice's coefficient is defined as twice the number of terms that are common in the compared texts, and divided by the total number of terms present in both texts.

3. Euclidean distance is measured by calculating the square root of the sum of the squared differences between the elements of two vectors.

4. The Jaccard coefficient is calculated so that the number of general terms is divided by the number of all unique terms present in both texts.

5. Cosine similarity. When documents are presented in the form of vectors, the degree of similarity can be measured as their correlation, and this is usually quantified by using cosine angles between two vectorized documents [4].

The top N most similar texts for the query can be ranked by calculating one of the measures given and returning N texts with the smallest measure value.

Based on the results of many studies presented in [1], [2], [3], we can conclude that the cosine distance shows the best results compared to other similarity measures.

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**Аннотация.** В условиях работы в онлайн-сфере многие компании используют на своих интернет-платформах рекомендательные системы, показывающие пользователю товары на основе его интересов и истории покупок. Для таких систем, которые строят рекомендации на основании описания товаров, ключевым моментом является вычисление похожести описаний.

В статье рассматриваются основные меры сходства, используемые для поиска похожих товаров по их описанию в рамках рекомендательной системы площадки электронных торгов.

**Ключевые слова:** рекомендательные системы, сходство текстов, TF-IDF, меры сходства, обработка естественного языка.

**Annotation.** Working online many companies use recommender systems in their Internet platforms to show products to its user based on his interests and purchase history. The key feature of systems that generate

recommendations built on product descriptions is a calculation of descriptions similarity.

The article discusses main similarity measures used to find similar products by their description within the recommender system of the electronic trading platform.

**Key words:** recommender systems, text similarity, TF-IDF, similarity measure, natural language processing.

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## **APPLICATION OF ANTENNAS WITH DIFFERENTIAL RADIATION PATTERN IN THE MARITIME SHIP MOORING SUPPORT SYSTEMS**

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**Introduction.** The main task of the ship navigator when approaching the mooring site in the port is to maintain the approaching course and maneuvering parameters within required accuracy. Specific requirements for these parameters are determined by the characteristics of the port and maneuvering properties of the ship. Different mooring operation information support systems including radio-based ones are applied to ensure safe maneuvering in both manual and automatic steering modes. Radio-based systems have several advantages over, for example, laser-based systems such as wider coverage area, not needing high radiation power as well as complex and expensive signal processing devices. The aim of this research is to estimate possibility of improving quality of the mooring support systems by using antennas with a differential radiation pattern.

**Materials and methods.** Unlike steering ships in open waters which includes keeping the ship on a set course, “maintaining the ship at the predetermined path, maintaining required speed and dynamic positioning” [1, p. 59-83], more stringent requirements are imposed on mooring operation information support systems with regards to their accuracy, responsiveness

and reliability because maneuvering takes place at a short distances from the piers and other vessels within limited time frame. Typically, due to these reasons several mooring support systems are employed simultaneously which are based on different operational principles thus reducing the probability of “blinding” of the systems due to insurmountable physical conditions (for example, optical system failure due to a dense fog).

“Radio assisted mooring support systems belong to beacon navigational systems of angle-measuring or angle/distance-measuring type” [4, p. 45-47] and once coupled with the ship steering systems [3] “they aid in dynamic steering of the ship” [4, p. 71]. We are particularly interested in angle-measuring systems of two-positional type consisting of a stationary radio beacon (*RB*) and shipborne direction finder which detects direction towards *RB* (course angle  $\theta_p$ ) by detecting its radio radiation.

The main methods for direction finding are: amplitude with signal maximum (AMAX), amplitude with signal minimum (AMIN) and phase (PH). To implement AMAX method, in addition to the receiver the shipborne equipment shall include an antenna with a narrow radiation pattern at half power  $2\theta_{0.5}$ , because when finding angle  $\theta_p$  it is  $2\theta_{0.5}$  that contributes to the error in finding this angle (Fig. 1 *a*). Implementation of AMIN method is based on finding the direction towards *RB* at the moment when it “looses” the signal (Fig. 1 *b*) which is possible when the antenna has a radiation pattern of a special shape, such as differential radiation pattern (DRP) featuring two lobes with “zero” at a given direction. With PH method, the shipborne antenna can be omnidirectional, however the shipborne equipment shall be capable of finding direction  $\theta_p$  based on intersection between radiation phase front of *RB* –  $PF_{RB}$  and spherical phase front  $PF_{SDF}$  (Fig. 1 *c*).

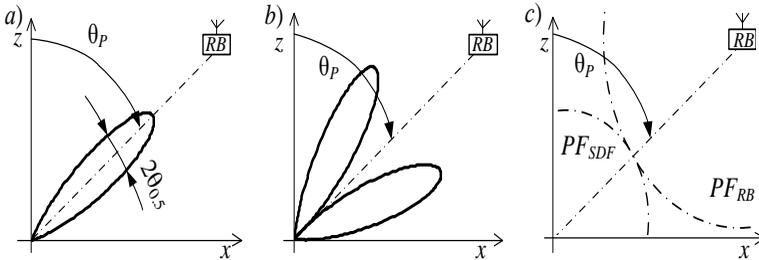


Fig. 1. For the clarification of methods for finding direction towards the radiation source: AMAX (*a*), AMIN (*b*), PH (*c*)

One of the advantages of the AMAX method is that the angle  $\theta_p$  can be measured directly, while disadvantages are due to the need for using a narrow-beam antenna – such antennas have large overall dimensions and

need to be pointed at  $RB$  by using high-precision and therefore expensive and bulky rotary mechanisms. On the contrary, omnidirectional antenna for PH method is easy to realize and does not require pointing however precision phase metering is quite complicated which results in phase direction finders to be typically relatively expensive.

AMIN method based direction finder can become an acceptable compromise. Firstly, it follows from the antenna general theory that “in order to create DRP it is sufficient to have two antenna components of any kind with antiphased excitation” [5, p. 349-351]. Secondly, the range of angles within which the distance finder needs to be capable of working during the mooring operations is limited by the nature of operations themselves (e.g. when mooring alongside the angle between the pier wall and approaching course is between  $35^\circ$  to  $50^\circ$ ) which means that should the DRP lobes have sufficient width there would be no specific need to turn the antenna.

We will determine if a non-rotary antenna with DRP can be used or not. One of the two approaches is available to find the direction towards  $RB$ : rotate radiation “zero” by altering phasing ratios in the antenna exciter or compare amplitudes of signals received from the two channels. The first approach requires considerable complication of the signal processing circuit in the receiver, while the second one would require application of two antennas spaced apart on the ship while offering relatively simple amplitude processing of the channel signals. Provided that the ship dimensions are such that antennas can be placed at sufficient distance from each other and antennas themselves are compact and inexpensive, this approach would allow us to create an angle-measuring system with acceptable weight/dimensions and precision.

**Results.** Let us assume that while selecting an approaching course towards the mooring point the ship is at the distance  $D$  to it and antennas are placed in transverse direction at the base distance  $B$ . If axes of antenna DRPs are parallel to the centerline of the ship, positional parallaxes of  $RB$  relative to the right-channel antenna  $\theta_R$  and left-channel antenna  $\theta_L$  will be equal in value but opposite in sign to each other (Fig. 2 *a*). Therefore signal voltages measured at the outputs of the right channel  $U_R$  and left channel  $U_L$  will be equal (Fig. 2 *b*).

Should there occur an angular deviation from the course  $\delta$ , relation between  $U_R$  and  $U_L$  will change by the value of  $\Delta U$  and provided sufficient sensitivity of the comparison circuits an error signal will be generated and either displayed on the course indicator if the ship is in manual steering mode or used by the control system to adjust the course if the ship is in automatic steering mode.

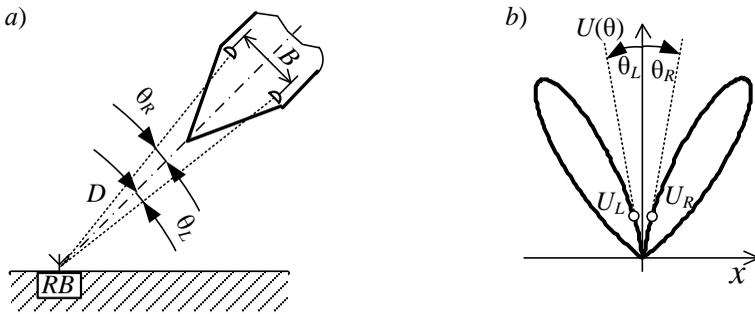


Fig. 2. Schematic showing approaching to the mooring point (a) and relative levels of the channel signals (b)

Paper [2] analyses DRP of the above type for even number of omnidirectional radiating elements of “Hertz’s elementary dipole” type [4, pp. 7, 422] placed at the distance  $d$  from each other and at the height  $h$  above the flat screen. Normalized DRP  $U(\theta)$  for both radiating elements can be presented as follows:

$$U(\theta) = \sin\left(\frac{\pi d}{\lambda} \sin \theta\right) \sin\left(\frac{2\pi h}{\lambda} \cos \theta\right),$$

where  $\lambda$  – wavelength.

Difference between signal levels of the right and left channels can be found using the formula:

$$\Delta U(\delta) = U(\theta_R + \delta) - U(\theta_L + \delta) = U(\theta_R + \delta) - U(-\theta_R + \delta),$$

where it is taken into account that the angular deviation is towards one side.

Typically “value  $d$  is selected close to the half-wavelength, while  $h$  – to the quarter-wavelength” [4, pp. 243-245]. We will perform some quantities assessments for these values, while “assuming the acceptable angular deviation error  $\delta$  of about  $1^\circ$ ” [1, p. 100].

When parallax  $\theta_R$  is also equal to  $1^\circ$  the minimum signal level in each channel will be about 0.03 or near  $-30$  dB compared to the maximum value. When deviation error  $\delta$  equals to  $1^\circ$ , the signal in one of the channels will increase by 0.07 or 6 dB relative to the minimum signal. Modern electronic devices are capable of working with such signal levels so we still need to find out if the proposed system can be of a practical interest to the ship navigators.

Let us assume the base distance  $B$  between the antennas is 10 m which is a quite realistic value for medium-capacity ships. Distance  $D$  where the above geometrical conditions are met will be as follows:

$$D = \frac{B}{2\text{tg}\theta_R} = \frac{10}{2\text{tg}1^\circ} \approx 300 \text{ m.}$$

**Discussion and conclusions.** It was shown that safe approaching of the ship to the mooring site can be achieved by using an angle-measuring radio system of the beacon type that consists of a radio beacon with omnidirectional antenna installed at the mooring point and a shipborne two-channel receiver which receives and compares signal levels from two antennas with radiation patterns of a special type. The two-element antennas with two-lobe radiation patterns with “zero” in the main direction and distance between them of 10 m make it possible to ensure at least 300 m range of the system which can be of a practical interest to the ship navigators.

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**Аннотация.** Для обеспечения безопасности операций швартовки морских судов предлагается использовать маячную радиосистему угломерного типа. Система содержит радиомаяк с ненаправленной антенной, установленной в месте швартовки, и судовое оборудование в виде двухканального пеленгационного приёмника и двух антенн с диаграммой направленности разностного типа: два лепестка с «нулём» в направлении курса подхода судна. При отклонении от курса приёмник вырабатывает сигнал ошибки, который позволяет вернуть судно на точный курс. Показано, что при допустимом отклонении  $1^\circ$  дальность действия системы составит не менее 300 м.

**Ключевые слова:** швартовка, угломерная радиосистема, пеленгация, метод минимума, антенна с разностной диаграммой направленности.

**Abstract.** To ensure safety of the marine ships during mooring operations it is proposed to use a beacon-based radio system of the angle-measuring type. This system includes a radio beacon with omnidirectional antenna installed at the mooring site and shipborne equipment such as two-channel direction finding receiver and two antennas with differential radiation patterns featuring two lobes with “zero” along the ship approaching course. In case of deviation from the course the receiver generates an error signal which allows the ship to be steered back to the correct course. It was shown that the range of the system will be no less than 300 m for deviations not exceeding 1°.

**Keywords:** mooring, angle-measuring radio system, direction finding, minimum method, antenna with differential radiation pattern.

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## **MOISTURE METER FOR DRY MATERIALS**

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### **1. Introduction**

A method and a device for measuring the moisture content of various dry and liquid materials is known from the technical literature. It is based on the use of RF and microwave resonators containing controlled material [1].

Despite all the advantages of the method, it also has a disadvantage, which consists in its limited scope of application, due to a small change in the informative parameters (resonant frequency, q-factor of the resonator, etc.)

The purpose of this work is to improve the accuracy and performance of measurements.

To eliminate this disadvantage, two-channel measuring circuits with independent measuring and reference channels are used. In the reference channel, the sensor element contains material with known physical properties

[2]. The disadvantage of this technical solution is the need to apply different reference elements in each case.

## 2. The substantiation of proposed method and meter on its basics

One of the most promising methods for measuring the humidity of materials in the ultrahigh frequency range is a method that involves indirect measurements of the parameters of the electromagnetic wave at two frequencies. Sources of electromagnetic waves are switched on alternately. The results of measurements and processing of measurement information allow to get the desired percentage of water content in the controlled bulk material.

Figure 1 shows a block diagram of the meter. The meter works as follows. The microwave *generator 1* produces electromagnetic waves that alternately pass through the microwave switch and enter the input of the transmitting horn antenna. Receiving horn antenna, obtains re-emitted electromagnetic waves. At the output of the microwave detector, there are voltages that carry information about the humidity of the material in the first and second cycles.

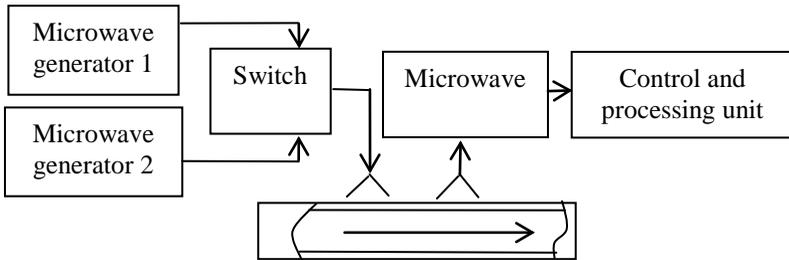


Fig. 1 — Block diagram of the moisture meter for dry materials

The amplitude of the electric field strength  $E$  is an informative parameter. In the first and second cycles, the amplitudes of the electric field strength are measured  $E_1, E_2$

$$E_1(\varepsilon) = E_{10} e^{-\alpha_1 l}, \quad (1)$$

$$E_2(\varepsilon) = E_{20} e^{-\alpha_2 l}, \quad (2)$$

where

$$\alpha_1 = \frac{2\pi f_1}{c} \sqrt{\left(\frac{c}{f_1 \lambda_{KP}}\right)^2 - \varepsilon_{1 \text{ CMRCH}}(f_1)};$$

$$\alpha_2 = \frac{2\pi f_2}{c} \sqrt{\left(\frac{c}{f_2 \lambda_{\text{КР}}}\right)^2 - \varepsilon_{2\text{СМЕСИ}}(f_2)}.$$

The value of the permittivity of a moisture-containing dielectric having a permittivity  $\varepsilon_{\text{ДИЭЛ}}$  and moisture content  $W$  is described for small  $W$  by the formulas [2, 3, 4]:

$$\varepsilon_{\text{СМЕСИ}} \approx \varepsilon_{\text{ДИЭЛ}} \left(1 + \frac{3W}{D(f) - W}\right); \quad (3)$$

$$D(f) = \frac{\varepsilon_{\text{ВОДЫ}}(f) + 2\varepsilon_{\text{ДИЭЛ}}}{\varepsilon_{\text{ВОДЫ}}(f) - \varepsilon_{\text{ДИЭЛ}}}, \quad (4)$$

where  $\varepsilon_{\text{water}}(f)$  — the permittivity of water, which is a function of frequency  $f$ .

When considering (3) and (4) as a system of equations and solving it due to the desired moisture content  $W$ , we get

$$W = \left( \frac{1}{3} \cdot \frac{\varepsilon_{1\text{СМЕСИ}} - \varepsilon_{2\text{СМЕСИ}}}{\frac{1}{D_1} \cdot \varepsilon_{1\text{СМЕСИ}} - \frac{1}{D_2} \cdot \varepsilon_{2\text{СМЕСИ}}} \right). \quad (5)$$

Taking into account formulas (1) and (2), expression (5) takes the following form:

$$W = \frac{1}{3} \frac{\frac{1}{\lambda_{\text{КР}}^2} \left( \frac{1}{f_1^2} - \frac{1}{f_2^2} \right) - \frac{1}{(2\pi l)^2} \left[ \left( \frac{\ln E_{10}/E_1}{f_1} \right)^2 - \left( \frac{\ln E_{20}/E_2}{f_2} \right)^2 \right]}{\frac{1}{D(f_1)f_1^2} \left[ \frac{1}{\lambda_{\text{КР}}^2} - \left( \frac{1}{2\pi l} \ln E_{10}/E_1 \right)^2 \right] - \frac{1}{D(f_2)f_2^2} \left[ \frac{1}{\lambda_{\text{КР}}^2} - \left( \frac{1}{2\pi l} \ln E_{20}/E_2 \right)^2 \right]}} \quad (6)$$

Formula (6) can be written in a more compact form

$$W = \frac{1}{3} \cdot \frac{k_1 - k_2 \ln^2 \frac{E_{10}}{E_1} - k_3 \ln^2 \frac{E_{20}}{E_2}}{k_4 - k_5 \ln^2 \frac{E_{10}}{E_1} - k_6 \ln^2 \frac{E_{20}}{E_2}} \quad (7)$$

where  $k_1, k_2, k_3, k_4, k_5, k_6$  — constant values:

$$k_1 = \frac{1}{\lambda_{\text{КР}}^2} \left( \frac{1}{f_1^2} - \frac{1}{f_2^2} \right); \quad k_2 = \frac{1}{(2\pi f_1)^2}; \quad k_3 = \frac{1}{(2\pi f_2)^2};$$

$$k_4 = \frac{1}{D(f_1)f_1^2 \lambda_{\text{КР}}^2} - \frac{1}{D(f_2)f_2^2 \lambda_{\text{КР}}^2};$$

$$k_5 = \frac{1}{D(f_1)} k_2; \quad k_6 = \frac{1}{D(f_2)} k_3.$$

Thus, by performing a joint conversion of the measured values of the amplitudes  $E_1$  and  $E_2$  according to the ratio (7), we obtain the value of the moisture content  $W$ .

The resulting error in measuring the humidity of bulk materials is calculated using the formula

$$\delta_W = \sqrt{(\delta_{f_1})^2 + (\delta_{f_2})^2 + (\delta_{\epsilon_{\text{водны}}})^2}. \quad (8)$$

The analysis of the dependence on errors caused by the inaccuracy of setting the frequency  $f$  of microwave generators 1 and 2, the inaccuracy of determining the permittivity of water  $\delta_{\epsilon_{\text{водны}}}$  shows that the maximum error in measuring  $W$  of dry materials is no more than 2.25 %.

На рис.2 показана структурная схема двухчастотного измерителя влажности сыпучих материалов. Picture 2 shows the block diagram of a two-frequency moisture meter for dry materials.

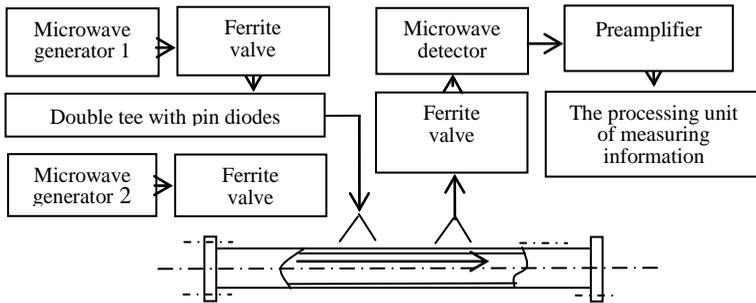


Fig. 2 — Block diagram of the moisture meter for dry materials

### Conclusion

The research of the two-frequency method of measuring the humidity of dry materials allows to make the following conclusions:

- the study of the capabilities of the meter based on the two-frequency method was carried out;
- the main advantages of this method are simplicity of implementation and high accuracy of measurement;

- humidity measurement error due to inaccuracy of setting the frequency of the microwave generator 1 does not exceed 1 % ;
- humidity measurement error due to inaccuracy of setting the frequency of the microwave generator 2 does not exceed 0.75 % ;
- humidity measurement error due to inaccuracy of definition does not exceed 1.15 % ;
- the resulting error in measuring the humidity of dry materials does not exceed 2.25 % , which meets modern requirements.
- the possibility of controlling the humidity of dry materials during their continuous production is proved.

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**Аннотация.** Совершенствование методов контроля качества сыпучих материалов в потоковом производстве способствует снижению себестоимости производимой продукции и увеличению объемов продаж. Контрольно-измерительная аппаратура, в свою очередь, непрерывно должна повышать свои метрологические характеристики и уровень автоматизации процесса измерения.

Анализ показал, что микроволновые методы в настоящее время являются наиболее перспективными. Однако для оптимизации процесса контроля выпускаемой продукции целесообразно выбирать такой метод и аппаратуру на его основе, который бы способствовал повышению технико-экономических показателей всего производственного цикла предприятия.

Цель разработки — повышение точности измерений.

Двухчастотный метод измерения влажности ориентирован на поточное производство сыпучих материалов и обеспечивает создание измерительного комплекса с высокими метрологическими показателями. Источниками электромагнитных колебаний являются полупроводниковые генераторы. Коммутатор на *pin*-диодах поочередно подключает эти генераторы к передающей антенне. Приемная антенна принимает прошедшую через исследуемый материал волну. На выходе

СВЧ детектора появляется напряжение, несущее информацию о влажности сыпучего материала. Устройство обработки работает по определенному алгоритму, осуществляя коррекцию результатов измерения с целью повышения точности.

**Ключевые слова:** СВЧ генератор, двойной тройник с *pin*-диодами, СВЧ коммутатор, трубопровод, передающая антенна, приемная антенна, СВЧ детектор, погрешность измерения, диэлектрическая проницаемость, амплитуда напряженности  $E$  электрического поля, сыпучие материалы.

**Annotation.** Improving the quality control methods for dry materials in flow production provides the cost reduction of production and sales increasing. The control and measuring equipmen must continuously improve its metrological characteristics and the level of automation of the measurement process.

The analysis showed that microwave methods are currently the most promising. However, to optimize the process of product control, it is advisable to choose such a method and equipment based on it, which would contribute to improving the technical and economic indicators of the entire production cycle of the enterprise.

The purpose of the development is to improve the accuracy of measurements.

The two-frequency method of humidity measurement is focused on the in-line production of dry materials and provides the creation of a measuring complex with high metrological indicators. Sources of electromagnetic waves are solid-state generators. The *pin*-diodes switch connects these generators to the transmitting antenna. The receiving antenna obtains a wave which has passed through the test material. At the output of the microwave detector, a voltage appears that carries information about the humidity of the dry material. The processing device operates according to a specific algorithm, performing correction of measurement results in order to improve accuracy.

**Keywords:** microwave generator, double tee with *pin* diodes, microwave switchboard, pipeline, transmitting antenna, receiving antenna, microwave detector, measurement error, permittivity, electric field strength  $E$  amplitude, dry materials.

**USE OF REMOTE SENSING TOOLS IN ENVIRONMENTAL  
PROTECTION**

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***Introduction***

The relevance of this work is due to the constant growth of the world's population in combination with an increase in the material well-being of people and, as a result, an increase in the load on the environment, which, in turn, causes various negative consequences. The reduction of natural areas and the increase in pollution have become the main consequences of human activity. For the above reasons, it is not possible to completely stop the harmful impact on nature from the human side, but it is possible to reduce it by finding and reducing the most dangerous foci of anthropogenic emissions using remote sensing methods.

*Human anthropogenic impact on the environment. Environmental monitoring tools.*

After the industrial revolution and the Second World War in the first half of the XX century, humanity was faced with the problem of controlling the state of the environment. There was a need for tools for monitoring and estimating the current state of a particular area of nature, the dynamics of changes and an approximate forecast of further changes.

The first developments in this area were presented in the second half of the XX century. In the future, such groups of methods were identified as ground and remote, Ground includes physical and chemical, statistical and mathematical, biological, and others. methods of obtaining data, remote uses aviation, aerospace and marine [2].

The most effective way to monitor the anthropogenic impact on the environment is undoubtedly remote sensing – measuring the characteristics of natural and reflected radiation of the Earth's surface and atmosphere in

different ranges of electromagnetic waves. This includes measurements from artificial earth satellites and aircraft (planes and helicopters). Remote methods have a very important advantage over contact methods – they provide integral characteristics over large territories over the same, and sometimes shorter period of time. Space tools are the leaders in such methods.

The use of artificial earth satellites allows to obtain information about the state of forests, agricultural land, vegetation on land, phytoplankton in the sea, the state of soil cover, violations of the earth's surface, erosion processes, urbanized areas, the state of surface reservoirs, air pollution, seas and land with high accuracy of measurement.

*Modern aerospace systems for obtaining earth remote sensing data*

There are a large number of modern spacecraft that can provide remote sensing Data. Each satellite has a purpose. Some of them, which can perform tasks, related to environmental monitoring are discussed below.

The Canopus-V space complex currently consists of six spacecraft, the first of which was launched on July 22, 2012. It is intended to provide operational information to divisions of Roscosmos, EMERCOM of Russia, Ministry of natural resources of Russia, Roshydromet, RAS and other interested departments. Among the tasks facing the satellite are: detection of forest fires, large emissions of pollutants into the natural environment; monitoring of man-made and natural emergencies, including natural hydrometeorological phenomena; monitoring of agricultural activities and natural (including water and coastal) resources; land use; operational observation of specified areas of the earth's surface. Among the features of this complex, it is worth noting its high efficiency, as well as data support with coefficients of rational polynomials, which, in turn, speeds up the processing of the received information and increases accuracy [1].

Resurs-P is a series of spacecraft. The first was launched on June 25, 2013. It is worth noting that due to the deep integration of technologies implemented during the creation of the space complex, the system's capabilities are significantly higher than those of three Autonomous vehicles. The use of a circular sun-synchronous orbit with a height of 475 km can significantly improve the observation conditions. The frequency of observation was improved from six to three days. Shooting is performed in both panchromatic and 5-channel multispectral modes. In addition to high-resolution optical and electronic equipment, the satellite has a hyperspectral spectrometer (HSA) and a wide-range multispectral high-resolution (SMSA-VR) and medium-resolution (SMSA-SR) survey system. The Resurs-P space complex can be used to control pollution and environmental degradation, detect and study environmental pollution, control water protection and

protected areas, assess the state of the ice situation, and inventory natural resources to ensure rational activities in various sectors of the economy; monitoring of emergency situations; determining the type and condition of vegetation, the composition of the pollution film on the water surface, identification of minerals, soils, etc. The advantages of this satellite are ultra-high spatial resolution better than 1 meter and stereoscopic shooting, which allows you to create three-dimensional models.

Obzor-O is a new Russian grouping of remote sensing satellites with optical and electronic equipment that are designed to perform operational surveys of the territory of Russia, adjacent territories of neighboring States and certain areas of the Earth. The launch will be carried out in two stages, each of them will launch 2 satellites, in total, there will be four of them in the grouping. The launch of the first devices is planned for 2021. It is planned that this grouping will solve the following tasks: monitoring the state of forest vegetation, forest inventory; operational control of man-made and natural emergencies for the purpose of effective planning and timely implementation of measures to eliminate their consequences; monitoring of natural and man-induced disasters and others.

On August 29, 2008, five RapidEye satellites were launched. RapidEye spacecraft are equipped with the Reis multispectral imaging system (RapidEye Earth Imaging System), which is a three-mirror anastigmatic system that provides a survey of the Earth's surface in 5 spectral zones, a 78 km wide band with a spatial resolution of 6.5 m in the Nadir. These satellites are used for the following tasks: monitoring the state of forest vegetation, forest inventory; monitoring the transportation and production of oil and gas; monitoring of the ecological state of territories in the areas of oil and gas production, processing, transportation, and other mineral resources; monitoring the use of natural resources; monitoring natural disasters, etc.

Landsat-8 is an American remote sensing satellite, the eighth in the Landsat program. It was launched into orbit on February 11, 2013. To optimize the accuracy of determining the satellite's orientation, three high-precision astrodetectors (ar-3, two of which operate in active mode), a scalable inertial guidance system SIRU (Scalable Inertial Reference Unit), GPS receivers and two three-axis magnetometers are used. Improving the technical characteristics of the target instruments helps to reduce the level of radiometric distortion compared to the devices on previous Landsat satellites, and the use of more advanced CCD devices allows you to improve the signal-to-noise ratio and the quality of shooting. The devices measure 4096 different levels of reflected light. This satellite is able to solve the following environmental problems: monitoring and forecasting of waterlogging and

desertification, salinization, fires, floods, etc.; prevention and liquidation of emergency situations; environmental monitoring.

Thus, remote monitoring tools are more effective than ground-based methods because they are simpler and they can cover areas that are difficult to reach by land. There are a number of spacecraft, both Russian and foreign, concerning the most of the tasks assigned to this type of means.

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**Аннотация.** В данной работе рассматривается проблема антропогенного влияния на окружающую среду, развитие средств мониторинга последствий такого влияния, а так же проанализированы современные аэрокосмические системы получения данных дистанционного зондирования, наиболее полно отвечающие требованиям крупномасштабного ландшафтно-экологического картографирования с целью их дальнейшего использования в профилактике и в борьбе с последствиями антропогенного влияния на окружающую среду.

**Ключевые слова:** антропогенное влияние, природоохранная деятельность, дистанционное зондирование Земли, мониторинг окружающей среды, современные спутники.

**Annotation.** This paper examines the problem of anthropogenic influence on the environment, the development of tools for monitoring the consequences of such influence, as well as analyzes modern aerospace systems for obtaining remote sensing data that most fully meet the requirements of large-scale landscape and environmental mapping in order to further use them in the prevention and control of the consequences of anthropogenic influence on the environment.

**Keywords:** anthropogenic influence, environmental protection, remote sensing of the Earth, environmental monitoring, modern satellites.

## USE OF AUGMENTED REALITY IN EDUCATIONAL APPLICATIONS

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### **Information Technology in Education**

According to the comprehensive program “National Technological Initiative”, Russia sets a long-term goal – to create all the necessary conditions to establish Russia's technological leadership in the world market by 2035 [2]. The country's technological leadership is highly dependent on the level of professional competencies of the generation that this leadership will achieve. The use of innovative information technologies in the learning process contributes to the achievement of the greatest learning efficiency. The national project "Education", which determines newest educational methods in the Russian Federation for 2019-2024, is aimed at achieving global competitiveness of Russian education, as well as Russia's entry into the top 10 leading countries in the world in terms of the quality of education [3].

According to the national project “Education” information technologies are being included everywhere in the educational environment at all educational levels. The use of innovational information technologies will provide the possibility of implementing distance learning, also that will increase the motivation of the young generation due to modern multimedia devices. Information technologies could provide new educational content, which includes, in particular, 3D visualization, audio guides, 2D content. Thanks to the IT education can become truly continuous and open.

Among the most popular modern information technologies in the field of education, we can highlight Augmented and Virtual Reality (AR / VR) technologies. These technologies are included to a list of supporting end-to-end technologies of the Digital Economy of the Russian Federation program [1, 4].

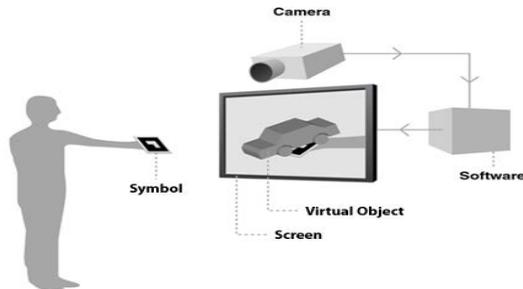
It seems appropriate to consider the experience of implementing modern information technologies, in particular, such as augmented reality, as tools that contribute to the development of educational motivation of students.

## Using augmented reality in education

Using computer graphics, computer vision and other technologies, virtual objects are superimposed on the real world thanks to augmented reality (AR). This enables users to see a new environment, which consists of a mixture of the real world and augmented reality content using interactive features (pic. 1) [7].

Augmented reality in education, according to experts, can increase the motivation of the younger generation to study due to the “wow” effect, it is also worth noting that augmented reality, due to its specificity, allows you to implement new learning mechanisms that are based on the use of visualization tools, which allows you to display more details about the object being studied, which helps to increase the level of perception of educational content and motivation for further learning [6].

Augmented reality can be implemented in many ways. There are different tracking technologies – marker and markerless tracking. Marker tracking is based on the detection of a special object – a marker, and then placing digital content on this marker (see pic. 2). Markerless technology is based on the use of computer vision algorithms to find suitable surfaces on which digital content can be placed [8].



*Pic. 1 – Augmented reality principle*



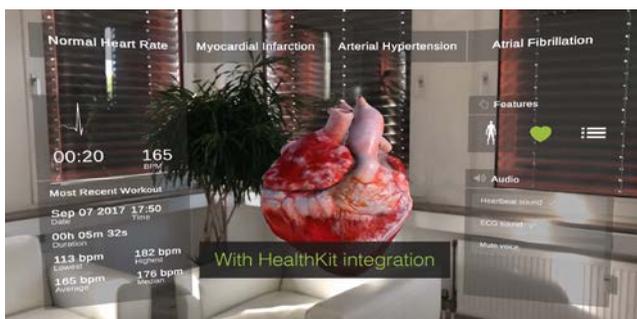
*Pic.2 – Recognition types in augmented reality*

There are some educational applications that use augmented reality. For example, the application “Brainapse by Designmate” in augmented reality explains the structure of the human skull, and also describes each stage of brain development. The developers added the ability to learn how the brain interacts with all the senses [5].

The advantage of this application is the realism of the developed 3D animation, as well as the simplicity of the educational material. The disadvantage is the presence of only the English version of the application, moreover that app has the narrow focus of educational content.

The Insight Heart application with the help of augmented reality displays how the human heart works, it has a detailed 3D model of the heart. With the help of animation, it visualizes different stages of heart development is implemented [5] (see pic. 4).

This app only supports English. Educational content is quite informative and entertaining, thanks to the use of 3D animation, as well as a beautiful UI interface.

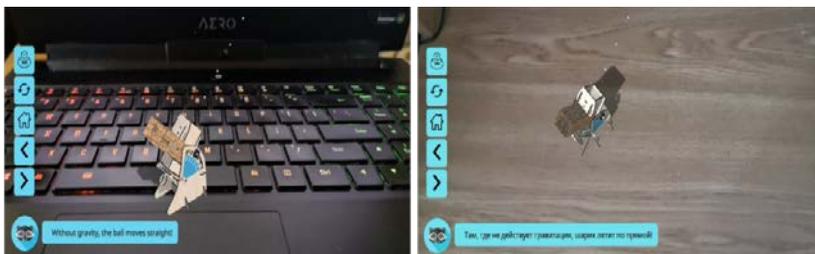


*Pic. 4 –Insight Heart app*

Existing educational applications using augmented reality can perfectly cope with the task of providing educational material in a beautiful, understandable form, but not every application supports several languages. To analyze the motivational effect of students using augmented reality, an application was developed.

#### **Developed educational application that used augmented reality**

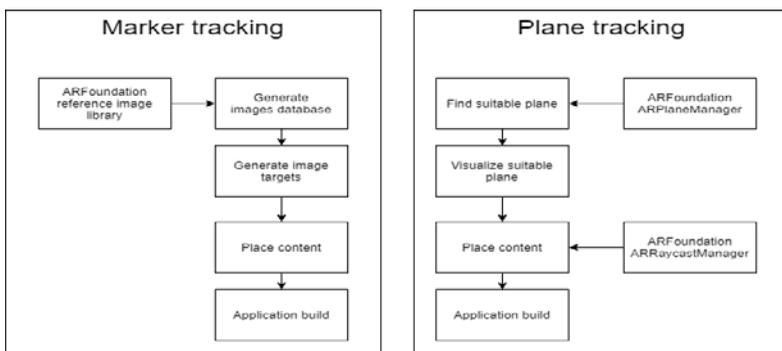
To test the effectiveness of using augmented reality technology in educational applications, a mobile game was developed that helps children (6-14 years) study the basics of physics (see pic. 5). It should be noted that this application supports any number of languages. A localization system was developed, it based on the generation of language dictionaries in JSON format and further processing of dictionary data to localize the user interface, educational content, and app audio.



*Pic.5 – An example of a developed application with AR*

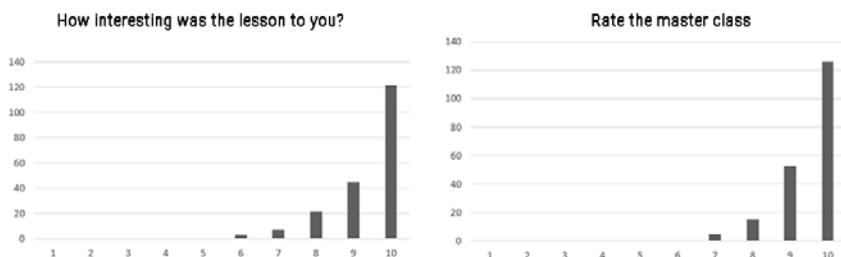
This application uses marker and markerless tracking technologies to display educational content on the surface or on a special marker. To develop this application, the cross-platform Unity3d engine, the C # programming language, and the AR Foundation AR development kit were used.

The development algorithm depends on the selected tracking technology; a schematic description of the development process is presented in pic. 6



*Pic.7 – Development process*

The use of this application for the purpose of teaching children physics (on a test group) has shown good results for student's motivation. The following topics of the curriculum in physics were included in the application: the basics of polarization, sound waves, gravity. At the end of each lesson, a survey was conducted in order to obtain feedback on the interest of students, the survey results were summarized in a final histogram (see pic. 7).



*Pic.7 – Test group survey histograms*

The use of animated 3D content, as well as interactivity elements increased the interest of students.

### **Conclusions**

To increase the effectiveness of the educational process, it is necessary to use advanced information technology. The use of augmented reality, as one of the supporting end-to-end technologies, in educational applications makes it possible to increase the motivation of the younger generation to study educational material in connection with the multimedia presentation: it is possible to use 3D animation, 2D animation, an audio and video guide.

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**Аннотация:** в статье отображены возможности использования дополненной реальности в обучающих приложениях. Описан опыт разработки подобного приложения, а также полученные результаты при анализе эффекта использования разработанного приложения в целях обучения детей. Разработанное приложение помогает детям изучать основы физики в игровой интерактивной форме, с использованием дополненной реальности, 3д анимации и аудиогuida. В качестве средств для разработки был выбран движок Unity3d, а также язык программирования C#.

**Ключевые слова:** дополненная реальность, обучающие приложения, ассистент, Unity3d, C#, обучение.

**Annotation:** the article displays the possibilities of using augmented reality in educational applications. The experience of developing such an application is described, as well as the results obtained when analyzing the effect of using the developed application for teaching children. The developed application helps children learn the basics of physics in an interactive game form, using augmented reality, 3D animation and an audio guide. The Unity3d engine, as well as the C # programming language, was chosen as a development tool.

**Keywords:** augmented reality, education tools, assistant, unity3d, c #, education.

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## **DEVELOPMENT OF MOBILE APPLICATION "SHAR" WITH THE POSSIBILITY OF USING AUGMENTED REALITY AND DYNAMIC CONTENT LOADING**

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### ***Relevance***

Crimea is a region of the Russian Federation that has a lot of cultural heritage sites. This is why there is an enormous flow of visitors. Statistics show that Sevastopol has the largest number of tourists. This is since the territory has unique historical and cultural monuments, including remains of the times of the Crimean War, World War II and other events. It has also preserved material evidence dating from the beginning of the VI century BC, which are now located on the territory of the State Historical and Archaeological Museum-Reserve of Tauric Chersonesos.

The Smart City project, launched in Sevastopol, involves the transformation of the urban environment through the use of information technology [1]. This transformation is expected to happen in several ways, which are determined by the Strategy of socio-economic development of the city of Sevastopol for 2030. One of the priority areas for development is tourism.

The fastest growing technologies in recent years are augmented and virtual reality technologies [4]. It was decided to use these technologies in order to increase the interest of the younger generation in history.

The augmented reality involves filling the real world with additional elements from digital reality. For example, displaying a 3D model, photo material, text information, video material on top of real world objects.

### ***Mobile application SHAR***

The developed SHAR mobile application acts as a platform that allows you to aggregate any number of museum complexes and their historical objects. The application uses augmented reality technologies to display additional information about historical heritage objects.

The first museum complex, which was connected to SHAR, was the ensemble of the memorial complex of monuments of the defense of the city in 1854-1855, 1941-1944 "Malakhov Kurgan." The application contains historical information, photo materials, as well as 3D visualized content on several objects of the external exhibition of the Malakhov Kurgan memorial complex. Due to the large amount of content uploaded to the application, a method of its delivery to the user's device is required in order to reduce the

final weight of the entire application. In the absence of a mechanism for delivering the desired content in real time, the weight of the application will increase each time with the addition of new locations, but the Appstore and Google Play app stores limit the starting weight of the application. In this regard, AssetBundles technology was selected for loading content in real time. The main task is to allow the user to download the data set for the selected museum complex, as well as the ability to delete the previously downloaded collection to clear memory on your device [2].

### ***Asset Bundles technology***

Asset Bundles is a technology that allows to create files which can be exported from the Unity editor and packaged into a file using its own compression format. This allows the developer to set the loading logic of various components, such as audio files, textures, 3D models. The main work with AssetBundles is to create a set of files for packaging and installing this assembly on the server. Also, the developer must consider the logic of choosing one or another assembly from the server using AssetBundles. Further operation of the technology consists of adding / removing assemblies and editing the logic of their loading. The process of storing asset bundles with necessary content takes place on the Unity3d development platform using AssetBundleBrowser. Bundles for the target platform are being assembled in the same window. After that, the generated files are uploaded to the server by FTP access. To download stored AssetBundles, a special class AssetBundlesLoader.cs was created. A part of the request code for the required set of bundles is presented below. The AssetBundlesLoader.cs class itself contains a larger number of lines of code, some of which are responsible for manipulating the assets downloaded from the server, and the other part is responsible for processing errors from the server, as well as functions that describe how to access previously loaded assets. The functionality of the cache system for downloadable assets is also described in this class.

```

IEnumerator DownloadAndCache (){
    while (!Caching.ready)
        yield return null;
    using(WWW www = WWW.LoadFromCacheOrDownload
(BundleURL, version)){
        yield return www;
        if (www.error != null)
            throw new Exception("WWW download had an error:" +
www.error);
        AssetBundle bundle = www.assetBundle;
        if (AssetName == "")

```

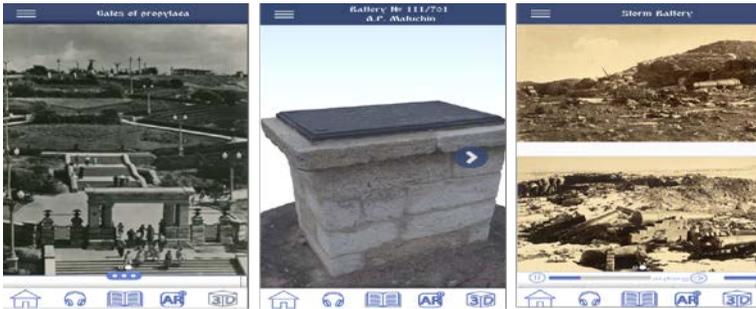
```

        Instantiate(bundle.mainAsset);
    else
        Instantiate(bundle.LoadAsset(AssetName));
        bundle.Unload(false);
    }
}

```

Picture 1 shows an example of content uploaded to a mobile application using Asset Bundles technology.

***App development process***

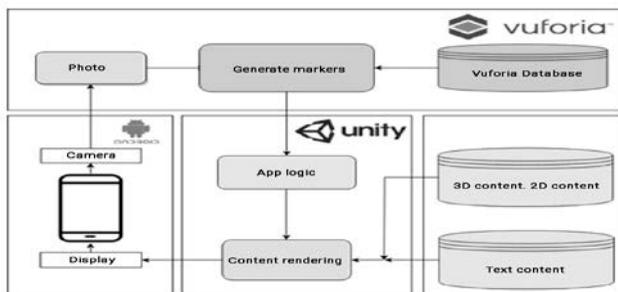


*Pic. 1 - Example of loaded information from bundles*

Using the Unity3d game engine, C # programming language, Vuforia augmented reality development kit, a mobile application was developed, the structural diagram of which is shown in pic. 2. It depicts the relationship between the main application modules and their corresponding technologies. This structure is typical for AR applications [3] developed using Unity and Vuforia.

The block that containing the application logic is central and provides control of the marker recognition subsystem through Vuforia tools, selection and loading of content, and control of the display of the interface using Unity. After activating the

augmented reality mode, an image is formed in the mobile device, which is transmitted for processing and matching based on the marker base. In the case of a successful match, content is generated corresponding to the object to which the AR marker is mapped. The content is formed as follows: information about the detected marker is transmitted to the application for processing and rendering. Rendering also interacts with a repository that provides content data to the application. After rendering is complete, everything is transferred to the phone display.



Pic. 2 – App architecture [4, p. 16]

For the developed application, the marker database on the Vuforia platform was configured. Each marker was specially selected to reach a high mark according to the Augmentable criterion (see pic. 3). The higher the score, the more points on the marker for which you can hook digital content in augmented reality.



Pic. 3 – AR mode

## Conclusions

As a result, a SHAR application was developed that uses augmented reality. Also, subsystem for downloading data from a web server through the use of AssetBundles technology was developed, which made it possible to reduce the weight of the application downloaded to the Google Play or Appstore application stores. The presence of this subsystem ensured the flexibility of this application and the ability to connect any number of memorial complexes and objects of cultural heritage. At the moment, the application allows you to view 3D models in augmented reality. Also, in the

form of a standard mode, you can view text, photo, 3D visualized information and listen to the audio guide.

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**Аннотация.** В статье описывается опыт разработки подсистемы подгрузки контента с веб-сервера для мобильного приложения SHAR, которое позволяет ознакомить пользователя с памятниками культуры и истории города Севастополя, используя технологии виртуальной реальности, просмотр 3D моделей и подробную контекстную справку. Также в тексте статьи подробно описан механизм работы выбранной технологии как до, так и после внедрения её в разрабатываемый проект. Помимо описания работы AssetBundles, в статье присутствует описание приложения и темы разработки. Для разработки были использованы: платформа разработки Unity3D, язык программирования C#, комплект разработчика AR – Vuforia, а также технология AssetBundles для подгрузки контента.

**Ключевые слова:** история, памятник, дополненная реальность, цифровые технологии, assetbundles, augmented reality, Unity3d, C#.

**Annotation.** The article describes the experience of developing a subsystem for loading content from a web server for the SHAR mobile application that allows to familiarize the user with the cultural and historical potential of Sevastopol city. Also in the text of the article, the mechanism of operation of the selected technology is described in detail both before and after its introduction into the developed project. In addition to the description of AssetBundles, the article contains a description of the application and development topics. Development stack were: Unity3D engine, the C #

programming language, the AR-Vuforia development kit, and AssetBundles technology for loading content were used.

**Keywords:** history, monument, augmented reality, digital technologies, assetbundles, Unity3d, C #.

UDC 004.921

### **3D CONTENT MODELING APPROACH FOR AUGMENTED REALITY APPLICATIONS**

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#### ***Introduction***

In September 2019, the Russian Federation hosted the final of the Digital Breakthrough competition for IT professionals, which was the largest hackathon in the world and entered the Guinness Book of Records. As part of the competition, development teams were asked to develop solutions to problems from real sectors of the economy and public life.

One of the teams of Sevastopol State University took on a task from the Ministry of Industry and Trade of the Russian Federation - to develop an AR/VR solution for quality control of the implementation of special technological processes at industrial enterprises.

The developed prototype was included in the top 10 solutions of the nomination, which made it possible in December 2019 to receive grant support from the Innovation Assistance Fund under the program “UMNIK – Digital Breakthrough 2.0”.

#### ***Augmented Reality in Industry***

The list of the most significant and basic cross-cutting digital technologies for the Russian Federation is defined in the National Digital Economy Program [1]. Among these technologies is augmented reality, which, according to the company's analytical research (PwC), is among the eight key technologies that will have a significant impact on the business in the near future [2].

Augmented reality (AR) implies the possibility of adding elements of the digital world to the real world. That is, it becomes possible to supplement a real physical object with a visual series of additional information: photographs, 3D-models, audio information, video information.

AR technology can be implemented using marker, markerless and spatial tracking.

Marker tracking is based on the recognition of a specially placed object in the outside world - a marker. As a marker, as a rule, images with high definition and contrast appear; when it is detected, elements of augmented reality are recreated. Markerless technology is implemented using computer vision algorithms that recognize real-world objects for which (or on which) you want to place digital content [4]. Spatial tracking is based on the geolocation and parameters of device sensors, information is generated and visualized depending on the spatial position of the observer, taking into account the orientation, angle of inclination and other parameters that are recorded by the sensors of the mobile device.

Existing industry solutions on the market, as a rule, are aimed at providing materials – instructions for carrying out technological operations, in order to facilitate familiarization with equipment, its operation and maintenance. Some solutions allow you to get the parameters of operations.

The Munich Institute of Technology has created a platform for industrial AR-solutions, which allows using portable devices to project augmented graphics on real products. Boeing with the help of AR solved the problem of installing components of on-board systems of aircraft, interconnected by a complex system of wires with control of installation parameters. Employees accelerated the assembly of harnesses and reduced the risk of making a mistake through the use of technology. Drillmec introduced augmented reality in the daily work of employees performing maintenance, monitoring and repair tasks in areas remote from the enterprise. Each of these solutions allowed either to increase the volume of work performed, or to reduce the number of errors made during technological operations.

### ***Special technological processes***

Special technological processes are processes whose results cannot be fully verified by subsequent control and testing of products and whose shortcomings can only be identified during the use of products.

That is, components and assemblies assembled with errors made in special technological processes are identified already at the operational stage, which for a number of industries (automotive, aircraft manufacturing, etc.) is often critical for human safety and / or entail large financial losses.

An example of such operations can be: hardening of holes by turning and sealing, which are carried out during the installation of critical parts in the manufacturing processes of products Tu-214, Tu-160, Tu-22M3.

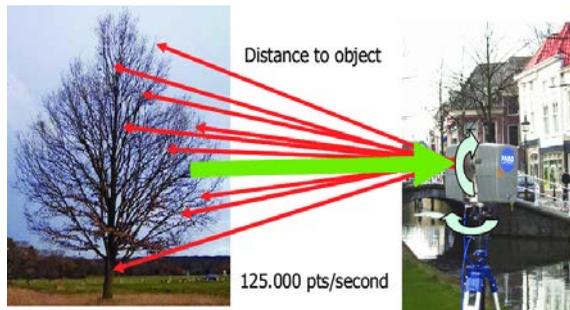
At the moment, the problem is solved by the presence of a person during a special technological operation, whose responsibility is to monitor the compliance of the process with the flow chart. As a rule, this is a specialist of higher qualification, and this, in turn, is an additional financial cost.

### ***3D Content Modeling Approaches***

Various techniques are used in particular to create 3D content and 3D models. There are three most common [3]:

1. Laser scanning;
2. Photogrammetry;
3. Modeling from scratch.

Laser scanning technology is based on the use of a laser. Laser scanner (see fig. 1) is a device for collecting point clouds from real-world objects. The principle of its operation is based on the emission of a stream of infected particles (laser) in different directions at a high speed (millions of operations per second). The beam reflected from objects is absorbed by the scanner, which allows you to determine the exact coordinates of the point from which the laser was reflected in space. Thus, a cloud of points is formed, from which you can subsequently create a 3D model.



*Figure 1 - Laser Scanner Example*

Photogrammetry technology allows you to create 3D models using photographs. A certain object is shot in various angles. Further, in a special program, photographs are processed in several stages:

1. Creation of engagement points (primary cloud);
2. Creating a dense cloud;
3. Creating a mesh model;
4. Creation of development and textures;

## 5. Model optimization;

After these steps, the object model is ready for use. Photogrammetry technology allows you to create high-range models of high quality and ultra-high detail in a relatively short time. Also, photos, in addition to creating the model itself, allow you to create textures for this model.

The modeling technology from scratch is based on building a model using special programs, Figure 2, directly on the computer. This technology is simple and reliable, since the modeler fully controls the process of creating the model and can predict the simulation result in advance. The resources required to create a model directly depend on the complexity of this model. The quality of the model depends on one of the programmer's knowledge of the program.

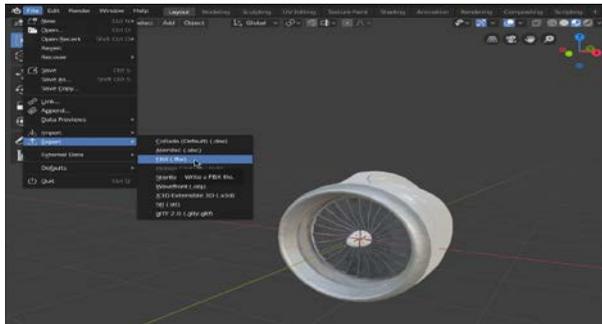


Figure 2 – Modeling window

### ***3D modeling approach chosen for the application***

Laser scanning allows to scan many objects at a time, which is ideal for modeling the environment. However, in order to create a complete model, it is necessary to perform scanning several times from different angles, and then combine point clouds in special programs. Moreover, to work with a huge number of points, large computing power is required, and the resulting clouds with the help of additional programs must be converted into 3D models.

Photogrammetry allows to create high-quality models, but in the same way as laser scanning requires large computing power. In addition, the complexity of creating a model is directly proportional to the size of the recreated object – the larger the object, the more resources will be required to model it. However, this technology is ineffective in creating models of small sizes and low detail.

Modeling from scratch is well suited for modeling objects of simple shape. Due to the ability to fully control the process, the modeler can create

simple models in a relatively short time. Therefore, to create 3D content of this application, it was precisely the modeling technology from scratch that was chosen.

### ***Proposed solution***

The proposed solution connected to the main enterprise data management systems, interacts with PLM, PDM, ERP systems. This is necessary to obtain process maps for special processes performed, as well as to implement a reporting system on the parameters of operations performed.

The developed solution is a client-server application with the ability to run on augmented reality glasses. The client is implemented using the Unity3D real-time 3D application development platform. The server part is implemented using php, MySQL, Mongo. Such an approach provides a competitive advantage in the form of the ability to collect, store and analyze the sequence of actions when performing special technological processes to generate a recommendation system to increase the efficiency of tracking the quality of special technological processes. It is also expected to generate reports on the work performed in the form of statistical time data, as well as the attached video, audio and photo materials on the work performed.

Using augmented reality in this solution allows you to:

1. Fix the correct execution of each technological operation (including special);
2. Report errors and provide instructions in the form of 3D images, audio guide, photo materials.
3. Generate a report on the completed technological process with execution parameters.

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**Аннотация.** В статье рассмотрена проблема контроля качества выполнения специальных технологических операций на производстве и

описано предлагаемое программное решение с технологией дополненной реальности (AR), описан процесс выбора подходящего способа моделирования 3D контента для данного приложения.

**Ключевые слова:** Специальный технологический процесс, дополненная реальность, контроль выполнения, средства обучения, ассистент, помощник augment reality, Unity3D, C#.

**Annotation.** The article considers the problem of quality control of performing special technological operations in production and describes the proposed software solution with augmented reality (AR) technology, describes the process of choosing the appropriate 3D content modeling method for this application

**Keywords:** special technological process, augmented reality, execution control, training tools, assistant, assistant augment reality, Unity3D, C #.

UDC 621.39

## **DEVELOPMENT OF NFC READER FOR ACCESS CONTROL SYSTEM**

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**Introduction.** In the modern world Near field technology (NFC) is widely used communication. This technology is used in various areas of life: electronic payment methods, access control systems, the relationship between devices, and others. NFC technology is based on the principles of radio frequency identification, that is, technology transmitting information over a radio channel that supports both active and passive channels devices. This principle of operation greatly facilitates everyday operation and increases the reliability of many systems [1].

The use of devices based on NFC technology in access control systems allows you to create effective security systems at the workplace and in the office, including mobile checkpoints or to control access to specific locations.

**Materials and methods.** Communication in NFC is carried out in the same way as in RFID technology. By inducing a magnetic field between two

frame antennas located within the near field of each other, a transformer with an air core is formed. This standard operates in the publicly available and unlicensed radio frequency range, the ISM band is an industrial, scientific and medical frequency of about 13.56 MHz and a bandwidth of almost 2 MHz. According to the type of operation and method of transmitting information, access control installations are Autonomous, network, and wireless.

Autonomous systems are systems that provide control over a separate (office, store, etc.) or several premises United by a common purpose, when the work is controlled by a separate (Autonomous) controller. In such installations, the control controller is not connected to other electronic control devices, but operates independently. The access point to the controlled territory is usually the entrance door. An electronic lock or latch is used as an Executive mechanism in Autonomous control systems, and the identifier is an access control card with various types of readers (bar, magnetic, proximity). An Autonomous controller usually works only "at the entrance" of the controlled territory, and "at the exit" control buttons or sensors are used.

Network systems are equipped with a more powerful and functional controller (or group) that ensures the operation of ACS in large areas where a large number of people can simultaneously be located. In such systems, access points are passageways or other structures, and turnstiles or gateways are used as the Executive mechanism. IDs can be of various types, and the actuators themselves are equipped with remote readers [2].

**Results.** The device being developed will solve the problem of accounting for students ' attendance at classroom classes. The device will consist of an antenna, a high-frequency NFC transceiver, a controller, and a Wi-Fi adapter. To configure the microcontroller, you can connect via USB.

Each student entering the classroom will have to attach an individual card to a high-frequency transceiver that uses NFC technology, where the ID from the card will be transmitted. The NFC transceiver is connected to the microcontroller via the SPI bus. From the microcontroller, data is transmitted via a Wi-Fi adapter to a remote host, which forms a database of students.

To solve this problem, the block diagram of a high-frequency NFC transmitter must include the following elements: a receiving antenna for directly reading or writing data to the card; a scheme for combining reception and transmission channels; a receiving channel for receiving and transporting information from the card; a transmission channel for writing information to the cards; a node for processing transmitted or received information; the UART interface manages the requirements for communication protocols together with the controller; a register Bank; FIFO buffer for fast and

convenient data transfer from the controller and UART and Vice versa; SPI interface for communication between the transceiver and the controller [3].

The controller is used for receiving information from a high-frequency transceiver and transmitting it to a Wi-Fi adapter for subsequent transmission to a remote attendance tracking server.

The study determined that the structural scheme of the controller should include: a CPU for controlling all processes; the SPI interface for communication of controller with high frequency NFC transceiver; interface GPIO for connection of the controller with the Wi-Fi module; UART interface for communication of controller with PC for firmware.

The Wi-Fi transceiver will transmit data about passing students to a remote server with a database. To solve this problem, the structure diagram of a Wi-Fi transceiver must include: the GPIO interface for communicating the transceiver with the controller; a microprocessor for connecting the device to the Wi-Fi network; an antenna for receiving and transmitting information in the Wi-Fi network. Figure 1 shows the developed flowchart.

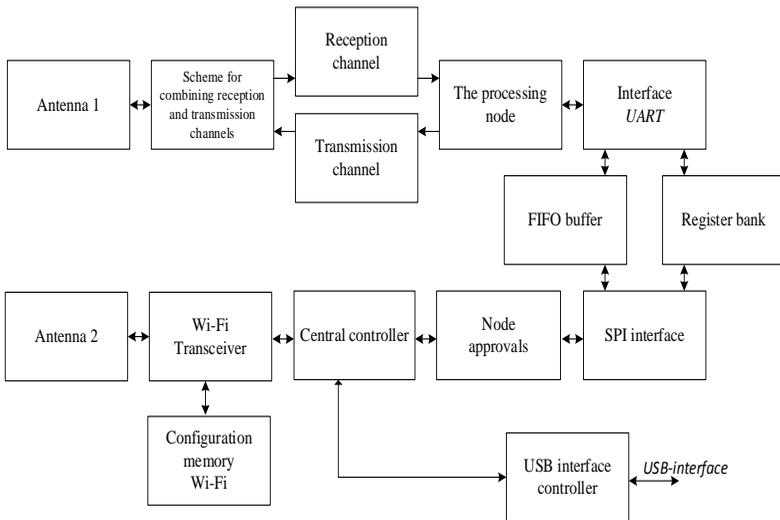


Fig. 1 — Block diagram of the device

**Discussion and Conclusions.** Thus, in the course of the work, a block diagram of the NFC reader was developed. The reader consists of the following elements: 1) a high-frequency NFC transceiver that will directly read data from cards at a frequency of 13.56 MHz and transmit card IDs to the controller; 2) a controller that will receive information from a high-frequency transceiver and transmit it to a Wi-Fi adapter for subsequent

transmission to a remote server; 3) the Wi-Fi transceiver will transmit data about passing persons to a remote server for saving in the database.

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**Аннотация.** В докладе рассматриваются этапы разработки считывателя, работающего по технологии Near field technology communication, для контроля посещаемости студентов. Обозначены основные узлы устройства, такие как: высокочастотный NFC считыватель; центральный контроллер для обработки данных, полученных со считывателя; приёмопередатчик, работающий по технологии Wi-Fi для последующей передачи данных; контроллер USB интерфейса для первоначальной настройки центрального контроллера. Разработана блок-схема устройства.

**Ключевые слова:** Wi-Fi, NFC, считыватель, микроконтроллер, контроль доступа

**Annotation.** The report discusses the stages of developing a reader that uses Near Field Communication technology to monitor student attendance. The main nodes of the device are indicated, such as a high-frequency NFC reader; a Central controller for processing data received from the reader; a transceiver operating on Wi-Fi technology for subsequent data transfer; a USB interface controller for initial configuration of the Central controller. A block diagram of the device has been developed.

**Keywords:** Wi-Fi, NFC, reader, microcontroller, access control

**RESEARCHING OF A CIRCULAR POLARIZATION ANTENNA  
FOR A 900-930 MHZ RFID SYSTEM**

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**Introduction.** In the ultra high frequency and microwave frequency ranges, the interaction between the reader and the RFID tag of RFID systems is carried out only through electromagnetic coupling. In RFID systems, there is usually no fixed mutual orientation between the mobile transponder antenna and the reader antenna. This can lead to random read range changes that are random in nature. This problem can be solved by using a circular polarization reader in the antenna [2, 3, 4].

**Materials and methods.** Circular polarization antenna provides uniform reading of tags with an random orientation. RFID systems operating in the far field often use resonant antennas. The ratio of the antenna size and the length of the emitted wave strongly influences the nature of the input impedance. The best relationship between antenna size and wavelength is the approximate equality of the length or perimeter of the antenna and the radiated wavelength.

If this equality is observed, the reactive part of the radiation resistance is minimal, and the active part tends to its maximum value. Consequently, the antenna begins to work as a resonator, thereby radiating more efficiently.

Currently, in all countries, the most commonly used RFID frequencies in UHF range (866-920 MHz). For further research, we selected 900-930 MHz frequency range.

**Results.** The objective is solved by using a patch antenna in the form of a disk [1]. It is an air-filled antenna without dielectric substrate. The antenna is linearly polarized as standard. To obtain circular polarization, it is necessary to cut off the edge of the disk and place the power point asymmetrically. The shape of antenna is shown in Fig. 1. The length of the antenna perimeter should be comparable with the central operating frequency of the antenna.

The diameter of the emitter is 140 mm, the shield is made in the form of a square with a side of 22 mm, the distance between ground plane and the radiator is 2 mm. Power is supplied via the SMA connector.

The antenna allows to provide the possibility of obtaining axial radiation with circular polarization for a microstrip structure with overall dimensions much smaller than the resonant wavelength, which allows you to create an antenna for identifying radio frequency tags of the range of 900-930 MHz.

The structure was modeled using the FEKO electrodynamic modeling package. Fig. 2 shows a three-dimensional radiation pattern of a circular patch antenna of circular polarization without a dielectric substrate. Fig. 3 shows a graph of the dependence of the VSWR on the frequency in the working frequency band.

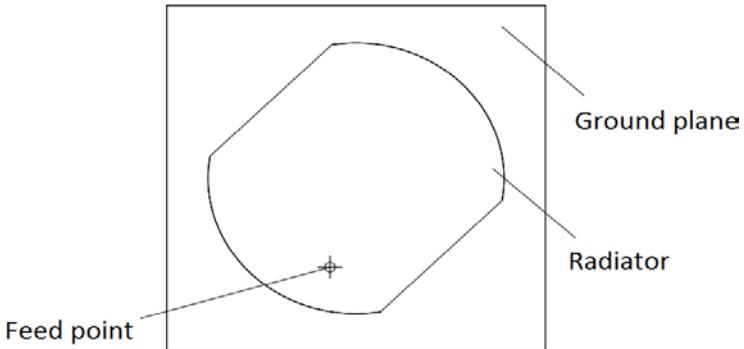


Fig. 1 — Shape of antenna

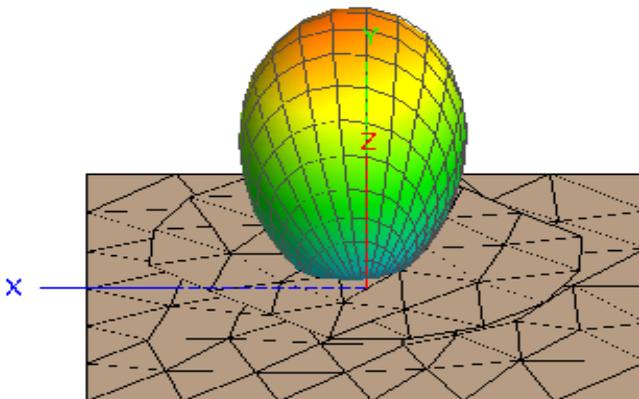


Fig. 2 — Three-dimensional radiation pattern of antenna

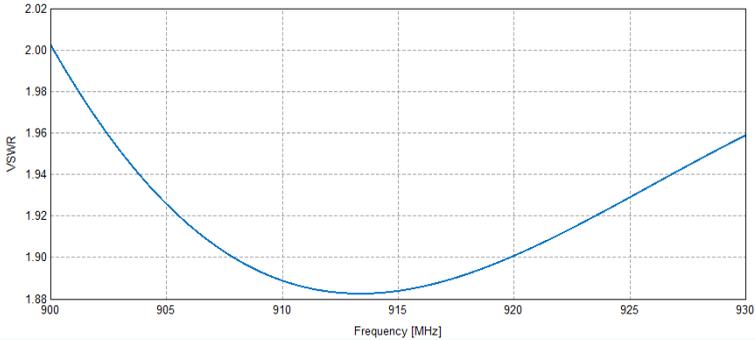


Fig.3 — VSWR distribution chart

**Discussion and Conclusions.** By modeling, a circular polarization antenna was created. The analysis of radiation patterns confirms the presence of axial radiation with a circular polarization orthogonal to the plane of the substrate. Gain in the operating frequency range is 8.8 dBi, VSWR not more than 2. The beam width of the directional diagram is 65 degrees in the vertical and horizontal planes. The ellipticity coefficient is 0.88. Using of patch antenna technology made it possible to obtain miniature antenna sizes without loss of performance. Selected technology simplifies the manufacturing of the device and provides high repeatability of the characteristics of the antenna. SMA connector allows to use an antenna with a 50 Ohms coaxial line.

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**Аннотация.** В докладе рассматривается малогабаритный микрополосковый излучатель на основе усеченного круга для системы радиочастотной идентификации диапазона частот 900-930 МГц. Выбранная конструкция антенны позволяет обеспечить излучение с круговой поляризацией в заданном частотном диапазоне. В результате моделирования получена патч-антенна с коэффициентом усиления в рабочей полосе частот 8,8 дБи и КСВ не более 2. Поляризация круговая правая. Ширина луча диаграммы направленности в плоскости излучения составляет 65 градусов, а коэффициент эллиптичности 0,88. Эквивалентное волновое сопротивление входа антенны составляет 50 Ом.

**Ключевые слова:** технология радиочастотной идентификации, радиочастотные метки, антенна, СВЧ, контроль доступа

**Annotation.** The report considers a small-sized microstrip radiator based on a truncated circle for a system of radio frequency identification of the frequency range 900-930 MHz. The selected antenna design allows for radiation with circular polarization in a given frequency range. As a result of the simulation, a patch antenna with a gain in the working frequency band of 8.8 dBi and VSWR of no more than 2 was obtained. The polarization is circular right. The beam width of the radiation pattern in the radiation plane is 65 degrees, and the ellipticity coefficient is 0.88. The equivalent impedance of the antenna input is 50 Ohms.

**Keywords:** radio frequency identification technology, RFID tags, antenna, UHF, access control.

UDC 621.391

## **DISTANCE LEARNING ORGANIZATIONS FOR IP TELEPHONY BASICS**

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**Introduction.** It is known that today IP telephony is increasingly replacing traditional telephony communication, mainly for the following reasons: ease of deployment, low cost of use, easy configuration, good communication quality and the ability to provide a secure connection. When training specialists in the field of telecommunications, special attention is paid to the study of configuring the Session Initiation Protocol (SIP) — one of the IP telephony protocols [3].

**Materials and methods.** The paper considers the possibility of implementing a laboratory work "IP telephony system Research" on the academic discipline "Fundamentals of building infocommunication systems and networks" for students of the training direction 11.03.02 "Infocommunication technologies and communication systems". The method of performing laboratory work is based on a sequential study of: the theoretical principles of packet telephony, the principles of building converting equipment and methods for configuring equipment on the example of the SIP Protocol.

In the case of IP telephony, voice signals are converted into data packets, which are then encoded. These data packets are then sent over the Internet to the receiving party. When data packets reach the destination, they are decoded into an analog voice signal. In this case, the voice signal is transmitted digitally over the communication channel and, as a rule, is converted before transmission in order to remove the redundancy of information that is present in the PCM signal, and as a result reduce the load on the data transmission network [2].

To connect an IP telephony system to a public switched telephone network (PSTN) when using voice gateways, the choice of a specific gateway option depends on the type and number of interfaces used to connect to the PSTN. Gateways are used when connecting an IP telephony system to a previously installed PBX.

Most of the gateway functions within the TCP/IP architecture are implemented in application-level processes. The rational solution of all the functions of signal processing and maintaining the telephone interface is usually performed on a digital signal processing processor. An example of a signal processing scheme in a gateway when connecting an analog two-wire PSTN telephone channel is shown in fig. 1.

The telephone signal from the two-wire subscriber line is transmitted to the differential system. then the signal goes to Analog to Digital Converter (ADC) and turns into an 8-bit signal encoded by A - or  $\mu$ - law. In the echo canceller, the remnants of the received signal are removed from the transmission signal. Detectors of the corresponding types are used to detect and determine signals of in-band multi-frequency telephone signaling (Multi

Frequency, MF), Dual Tone Multi Frequency (DTMF) or pulse signal sets [1].

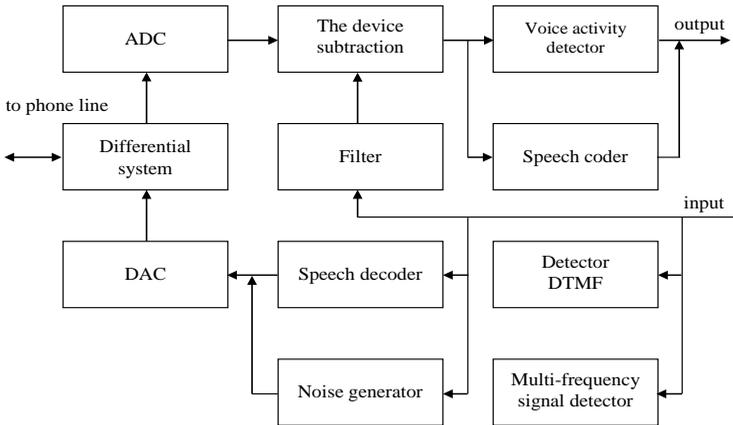


Fig. 1 — Telephone signal processing Diagram in a VoIP gateway

Further processing of the input signal occurs in the Speech Coder. In the encoder analyzer, the signal is divided into separate fragments of a certain duration (depending on the encoding method) and an information frame of the appropriate length is mapped to each input block.

Part of the parameters calculated in the encoder analyzer is used in the voice activity detector (VAD) block, which determines whether a speech signal or pause is received in the channel. If there is a pause, the information frame is not transmitted further. On the receiving side, the logical channel receives either an information frame or a sign that there is a pause.

On frames of pauses, instead of a speech synthesizer, the Noise Generator is turned on, which restores the spectral composition of the pause signal. The presence of an information frame includes a speech decoder, which generates a speech signal at the output. Depending on the type of digital to analog converter (DAC), the signal is encoded by A - or  $\mu$ -law. The task of implementing VAD is closely related to building codecs. The main difficulty is detecting speech pauses correctly against the background of intense acoustic noise, such as street noise or other sources.

Laboratory work is performed simultaneously by two students, each student installs software on their personal computer to perform laboratory work. You can perform laboratory work on portable devices, tablets, and

smartphones. To do this, you must provide Internet access on the devices you are using. A simplified block diagram of the equipment used for laboratory work is shown in fig. 2.

**Results.** To perform this work, we suggest using the MicroSIP software SIP phone, designed to work under the Windows operating system. After starting the MicroSIP program, go to the account settings mode and select the menu item "Edit Account", then fill in the form fields.

A sign of correct parameter input is the appearance of the Online label in the lower-left part of the program window. When performing the first part of the laboratory work, variants of IP telephony virtual PBX are used. A cloud or virtual PBX is hosted on the operator's servers (in the cloud), and the client does not need to install and maintain it on their own. Cloud PBX allows you to distribute incoming and outgoing calls from your office, home, or business.

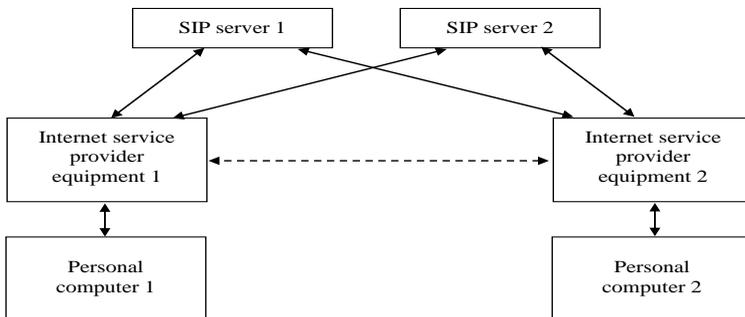


Fig. 2 — Block diagram of the laboratory installation.

The second part of the research requires you to prepare for the study of SIP connections using the Internet resource call2sip, to do this, open the main page of the site on the student's PC call2sip.ru. When you start the page, you may receive a request for permission to access the microphone, which you must answer in the affirmative.

Students after logging in to the site call2sip.ru, must exchange the sip addresses assigned by the service (using social networks or email, example of an address 05741778@call2sip.ru) and perform an alternate connection from the 1st student to the 2nd student and Vice versa, controlling the quality of communication by transmitting multiple sentences. The results of the connection should be evaluated on a 10-point scale and entered in the table.

**Discussion and Conclusions.** You can perform laboratory work on a tablet or smartphone. To do this, you can use programs for the Android operating system. For example, SIPDroid or Linphone. The report should

include the results of evaluating the quality of the connection in the echo test mode during a call and the amount of time delay.

It is important that the proposed research methodology for SIP technology ensures its implementation in remote mode, which is especially important in the conditions of the spread of coronavirus infection.

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**Аннотация.** В работе рассмотрена методика практического исследования и получения навыков настройки SIP оборудования студентами телекоммуникационных направлений, на примере организации лабораторной работы в дистанционном формате. Преимущества разработанной методики заключается в возможности реализации исследований на личных персональных компьютерах пользователей при использовании свободно распространяемого программного обеспечения и сетевых ресурсов IP-телефонии в Интернет. Предложенный вариант методики проверен практически весной 2020 г. на кафедре «Радиоэлектроника и телекоммуникации» Севастопольского государственного университета.

**Ключевые слова:** лабораторная работа, ADC, DAC, SIP, IP.

**Annotation.** In this paper, the method of practical research and obtaining skills for configuring SIP equipment by students of telecommunications areas, on the example of organizing laboratory work in a remote format, is considered. The advantages of the developed method is the possibility of implementing research on personal computers of users using freely distributed software and network resources of IP telephony on the Internet. The proposed version of the method was tested almost in the spring of 2020 at the department of Radioelectronics and telecommunications of Sevastopol state university.

**Keywords:** laboratory work, ADC, DAC, SIP, IP.

## FEATURES OF IMPLEMENTATION OF THE IP-TELEPHONY SYSTEM, BASED ON ASTERISK PBX

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**Introduction.** The initial tasks of organizing IP-telephony in the office is to create five jobs with the following functions: internal SIP numbers, SIP trunks (for making external calls using the SIP protocol), inbound and outbound routes, call forwarding capabilities, the ability to record telephone conversations, the possibility of forming a greeting, Interactive Voice Response (IVR). To solve the above problems, you can use the software implementation of the PBX — Asterisk [1].

Materials and methods. SIP is an application layer protocol of the OSI model that describes the methods and rules for establishing Internet sessions for exchanging multimedia information, such as sound, voice, video, graphics, etc. As transport protocols, SIP supports: UDP, TCP, SCTP, TLS. SIP protocol has a client-server model.

Private Business eXchange (PBX) is a telephone exchange that serves a private organization, permits sharing of central office connecting lines between telephones, and provides communication between internal telephones within an organization without using external lines.

Each device (telephone, fax, computer modem) connected to PBX is called an extension number and has a specific internal phone number, which can be automatically matched with the central office's numbering plan and the block of telephone numbers, designated PBX.

Using a private telephone exchange allows you not only to reduce the cost of internal phone calls, but also to implement services that are not available on a public network.

Asterisk PBX is a universal system for organizing IP telephony, which fully provides the functions of a regular telephone exchange. Asterisk is a virtual telephone exchange. To access it, you must connect to the corporate network of the enterprise.

**Results.** At the first stage, one IP-phone will be used to organize telephony. The remaining four analog phones will be connected to the

network via a DVG-5004S type VOIP gateway, which is intended for converting an analog telephone signal into a digital signal. Such a solution will reduce the cost of implementing the project. The selected gateway has four FXS ports, therefore, four analog phones can be connected to it. The block diagram of the equipment connection is shown in Fig. 1.

At the first stage, internal SIP-measures are created. In order to assign the created internal number to the IP phone, it is necessary to specify the address of the SIP server in the phone settings, as well as the username and password that were specified when creating the SIP number [2]. In the VOIP gateway, the login and password of the SIP number are separately assigned to each FXS port.

Next, SIP trunks are configured. The SIP trunk defines the set of properties required to make external calls using the SIP protocol. Such as authentication, callerid, number of channels, the presence of network broadcasts (NAT) and other properties for generating the correct SIP requests, the codecs used, the context for processing incoming calls, etc.

Settings are divided into three main sections:

1. Basic settings. The main parameters of the SIP trunk are determined;
2. Outgoing settings;
3. Settings for incoming connections.

Next, incoming connections are configured. This module handles incoming calls received from the standard FreePBX contexts - [from-trunk] and [from-pstn]. Calls can be distributed by DID (Direct Inward Dialing), Direct Incoming Dialing, or CALLERID of the caller [3].

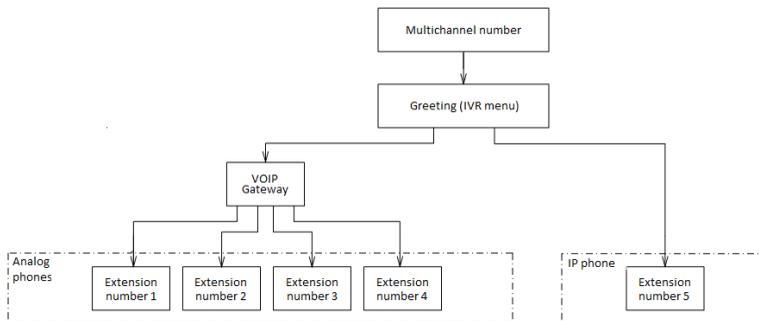


Fig 1 – System block diagram

Based on the dialed number, the direction (trunk) for the outgoing call is selected. The dialed number is divided into prefix and pattern and can be modified after dialing. Routes are checked in the order of listing.

PBX allows you to set up call forwarding between phones. The function is implemented as follows. When you press “##” on the telephone, a call diverting message appears. Then the extension number is dialed and “#” is pressed.

Greeting can be added using the interactive menu. IVR also allows the subscriber to choose the direction of his call (internal number or group of a call). The transition can be made not only by pressing a button, but also by timeout.

To record voice messages, you can use the corresponding module. If you want to record a greeting, you can use two methods:

- record a new system message using the web interface and phone;
- download the file from the computer.

The second option will be used, since the record downloaded from the computer can be pre-processed. Before you add an entry, you must reformat it to wav format. And encode as PCM, 16 bit and 8000 MHz.

**Discussion and Conclusions.** Thus, the report examined the possibilities of using the Asterisk virtual telephone exchange. Thanks to the software implementation, it was possible to create 5 working internal numbers with the ability to make incoming and outgoing calls. Also included was the ability to record and redirect calls and added a greeting at the beginning of a call.

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**Аннотация.** В докладе рассмотрена возможность использования коммуникационной платформы с открытым исходным кодом Asterisk для организации IP-телефонии в офисном помещении. Разработана структурная схема системы. Обозначены основные направления настройки Asterisk для создания правильно функционирующей IP-телефонии в офисе: создание внутренних номеров, SIP транков, входящих и исходящих маршрутов, возможности переадресации вызова между созданными номерами, добавление приветствия и возможности

записи разговора. Также рассмотрен пример настройки SIP телефона и VOIP шлюза.

**Ключевые слова:** SIP, Asterisk, телефония, внутренний номер, шлюз

**Annotation.** The report examined the possibility of using the open source Asterisk communication platform for organizing IP-telephony in an office building. A system block diagram has been developed. The main directions for setting up Asterisk for creating a properly functioning IP-telephony in the office are outlined: creating internal numbers, SIP trunks, incoming and outgoing routes, the possibility of forwarding a call between the created numbers, adding a greeting and recording capabilities of a conversation. An example of setting up a SIP phone and a VOIP gateway is also considered.

**Keywords:** SIP, Asterisk, telephony, extension, gateway

UDC 621.39

## **RESEARCHING OF A RADIATOR ON A MICROSTRIP-RING CIRCLE MEANDER LINE FOR RFID SYSTEM**

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**Introduction.** Modern technologies make it possible to use a radio frequency identification system to ensure tracking of objects in a warehouse. The problem arises of constructing miniature antennas with circular polarization to save space and simplify the implementation of the system. For this, it is proposed to use antennas of various shapes and configurations on dielectric substrates. One variation of such antennas is a patch antenna in the form of a circular meander line.

**Main part.** RFID systems often use resonant antennas. This means that the dimensions of the radiating antenna are proportional to the wavelength. The size of the antenna can be reduced by incorporating a dielectric substrate.

Then the antenna size decreases in  $\sqrt{\epsilon}$ , where  $\epsilon$  — the dielectric constant. If this equality is observed, the reactive part of the radiation resistance is minimal, and the active part tends to its maximum value. Consequently, the antenna begins to work as a resonator, thereby radiating more efficiently.

The task is implemented on the basis of the microstrip antenna type meander-line. In fig. 1 shows the variants of the antenna topology on the basis of a circular meander-line with different periodicity of the structure. An antenna for an RFID system is made on the basis of a dielectric with a relative dielectric constant of 5.6 with a conductor located on it, made in the form of a microstrip line of an annular shape, the external diameter of which is  $\lambda / \pi$ , where  $\lambda$  is the working wavelength.

The emitter has an outer diameter of 110 mm, internal 83 mm, with a microstrip conductor width of 4.5 mm. The width of the conductor was chosen based on the calculations carried out in the TXLine program in the AWR Design Environment software package.

The antenna allows to provide the possibility of obtaining axial radiation with circular polarization for a microstrip structure with overall dimensions much smaller than the resonant wavelength, which allows you to create an antenna for identifying radio frequency tags of the range of 866-915 MHz [1, 2, 3].

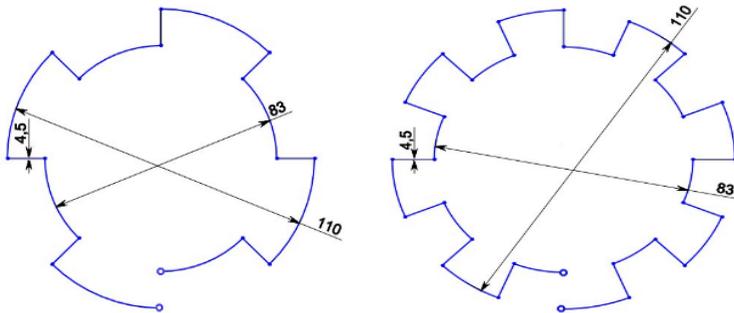


Fig. 1 – Antenna topology

The structure was modeled using the FEKO electrodynamic modeling package. Fig. 2 shows a three-dimensional radiation pattern with a four-segment meander line without a dielectric substrate. The report presents the results of modeling the input characteristics of the antenna.

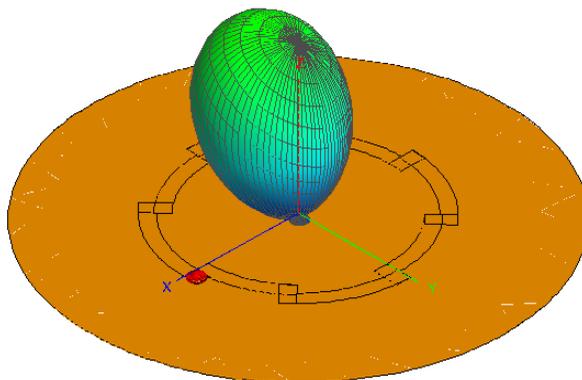


Fig. 2 — A three-dimensional radiation pattern

**Discussion and Conclusions.** As a result of the simulation, an embodiment of a circular polarized patch antenna based on a circular meander line was considered. The antenna has axial radiation with circular polarization. The influence of the periodicity of the meander, the width of the emitter, the size of the dielectric substrate and the position of the power point on the characteristics of the antenna is considered. The simulation results showed that this antenna configuration is not suitable for solving the problem. Since it was not possible to obtain a high gain and a standing wave coefficient of no more than 2 in the required frequency band of 866-915 MHz.

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**Аннотация.** В докладе рассматривается реализация малогабаритной патч-антенны для системы учета товаров в складском помещении. Предлагается использовать излучатель в форме меандрового кольца с разной периодичностью. В докладе рассмотрены

различные конфигурации выбранной модели. Проведен анализ влияния периодичности меандра на ширину диаграммы направленности, влияния ширины излучателя и размеров диэлектрической подложки на коэффициент усиления и ширину полосы пропускания, а также влияния расположения точки питания на согласование с линией питания с эквивалентным сопротивлением 50 Ом для системы радиочастотной идентификации в диапазоне частот 866-915 МГц.

**Ключевые слова:** технология радиочастотной идентификации, радиочастотные метки, антенна, СВЧ, складской учет.

**Annotation.** The report discusses the implementation of a small-sized patch antenna for a goods accounting system in a warehouse. It is proposed to use a radiator in the form of a meander ring with different periodicities. The report examined various configurations of the selected model. The influence of the meander frequency on the radiation pattern width, the influence of the emitter width and the dielectric substrate size on the gain and bandwidth, as well as the influence of the location of the power point on matching with the power line with an equivalent resistance of 50 Ohms for a radio frequency identification system in the frequency range 866-915 MHz.

**Keywords:** radio frequency identification technology, RFID tags, antenna, UHF, inventory control.

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## **REMOTE MODE FOR PERFORMING LABORATORY WORK ON THE STUDY OF NETWORK CONTROL TOOLS**

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**Introduction.** In connection with the spread of coronavirus infection, the Ministry of education and science of Russia switched the educational process of educational institutions to a remote format, which required the

adoption of emergency measures to adapt the educational process to the new conditions of implementation. Significant difficulties arise for engineering and technical specialties when organizing a laboratory workshop in a remote format [1]. For example, as when using professional laboratory installations [2]. However, for the educational disciplines of the telecommunications cycle of the enlarged group of directions and specialties 11.00.00 "Electronics, radio engineering and communication systems" for full-fledged laboratory work, it is possible to use home network equipment and Internet network resources, which is practically confirmed during training sessions in April - May 2020.

**Materials and methods.** The paper considers the possibility of implementing the laboratory work "Diagnostics of network operability and control of availability to packet switching nodes" in the discipline "Telecommunications systems" for students of the training areas 11.03.01 "Radio engineering", 11.03.02 "Infocommunication technologies and communication systems" and specialty 11.05.01 "Radio electronic systems and complexes". When performing the work, students get practical skills in monitoring and diagnostics of telecommunications networks. The result is achieved by experimenting with the health of network equipment and evaluating the availability of packet switching nodes.

One of the basic commands of the diagnostic tools is the ping command (Packet INternet Grouper—a tool for searching for network packets). Despite its apparent simplicity, this command is enough to solve many problems. The ping command exists on all network-enabled operating systems. The ping command tests the network connection by transmitting diagnostic packets to a specific node in the network. In turn, the node receiving such a packet must respond and confirm acceptance. If the response is received, the system is functional.

By sending echo messages over the Internet Control Message Protocol (ICMP), a connection at the IP network layer Protocol level is verified with another computer that supports the TCP/IP Protocol stack (Transmission Control Protocol / Internet Protocol). The ping utility works if the TCP / IP Protocol stack is functioning [3].

The ping utility is launched in the command console of the operating system (OS). For example, to start the command console in a OS Windows environment, click "start" — "Run", and type CMD in the command input field, completing the input by clicking OK.

The tracert utility command defines the path to the destination point by sending ICMP echo messages to the destination point with a constant increase in TTL lifetime values. The output path is a list of the closest router interfaces that are on the path between the source node and the destination

point. The near interface is the router interface that is closest to the sender node on the path.

This utility is a diagnostic tool designed to determine the route to the destination. Each router through which the path passes must reduce the value of its TTL field by at least 1 before further forwarding the packet. In fact, the TTL is the node counter. It is assumed that when the TTL parameter becomes 0, the router sends an ICMP message to the source system about the time elapsed.

The `tracert` command defines the route by sending the first echo request with a TTL field equal to 1, and increasing the value of this field by one for each subsequent echo packet sent until the destination node responds or until the maximum value of the TTL field is reached. The maximum number of clicks is 30 by default and can be changed using the `-h` parameter [4].

The path is determined from the analysis of ICMP time-out messages received from intermediate routers, and these are the destination responses. However, some routers do not send time-out messages for packets with zero TTL values and are not visible for the `tracert` command. In this case, a series of asterisks (\*) is displayed for the transition.

**Results.** The network configuration and equipment for performing laboratory work is shown in Fig. 1. The study is performed using a personal computer connected to the Internet.

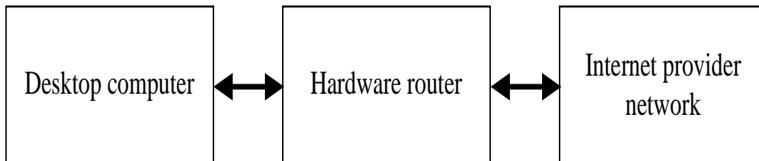


Fig. 1 — Block diagram of laboratory equipment

The laboratory work is performed according to the options. The option number is selected based on the last digit of the student's credit card. The initial data for performing the work is shown in table 1.

Table 1 — Initial data for performing laboratory work

Number of the research option	Internet Resource	Internet resource (alternate address)
1	list.ru	sevstopol.ru
2	sevsu.ru	newsru.com
3	rt-sevastopol.ru	mts.ru
4	rambler.ru	volnamobile.ru
5	yandex.ru	sevmobile.ru
6	google.com	amazon.com
7	test.com	gap.com
8	radio.ru	sport.ru
9	chat.ru	libking.ru
0	sevstar.net	mybook.ru

Next, you should investigate the response time for the specified network resource using the ping command. If there are problems with the main address shown in table 1, use the alternate address. When performing research, you should change the size of the transmitted packet in the following ranges of values:

— for the Internet resource:

32, 64, 128, 256, 512, 1024, 2048, 3072, 4096, 5120, 6144, 7168, 8192, 9216, 10240;

— for a local network resource (Run for the address of the nearest network device. This is usually the main gateway, defined using the ipconfig command):

1000, 2000, ..., 10000, (in increments of 1000);  
 20000, 30000, ..., 60000 (in increments of 10000).

If it is impossible to perform research for any combination of parameters due to the remote server's failure to execute the command, make a note of this fact in the results table. Based on the results of laboratory work, it is necessary to draw reasonable conclusions that reflect the features of the results obtained for all stages of the study. Next, trace the resources specified by the task using the tracert command.

**Discussion and Conclusions.** The proposed version of laboratory work shows the possibility of organizing remote research for educational disciplines of the telecommunications cycle, which is shown by the example of the laboratory work "network health Diagnostics and monitoring of availability to packet switching nodes". In addition, the method provides an

opportunity to observe the regime of self-isolation, minimize social contacts and implement all recommendations to prevent the spread of coronavirus infection.

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**Аннотация.** В работе рассмотрена возможность организации лабораторного практикума в дистанционном формате для инженерных направлений подготовки, что особенно актуально в условиях распространения новой коронавирусной инфекции. Проблематика вопроса связана с невозможностью реализация подготовки студентов по некоторым направлениям без реальной работы студентов с профессиональным оборудованием. Целью работы является определение возможности реализации лабораторного практикума для укрупненной группы направлений и специальностей 11.00.00 «Электроника, радиотехника и системы связи». Предложенный вариант организации исследований для учебных дисциплин телекоммуникационного цикла успешно апробирован весной 2020 г. в Севастопольском государственном университете.

**Ключевые слова:** лабораторный практикум, дистанционный режим, сетевое оборудование, ping, tracert

**Annotation.** The paper considers the possibility of organizing a laboratory workshop in a remote format for engineering training areas, which is especially relevant in the context of the spread of a new coronavirus infection. The issue is related to the inability to implement training of students in some areas without the actual work of students with professional equipment. The purpose of the work is to determine the possibility of

implementing a laboratory workshop for an enlarged group of directions and specialties 11.00.00 «Electronics, radio engineering and communication systems». The proposed variant of organizing research for educational disciplines of the telecommunications cycle was successfully tested in the spring of 2020 at Sevastopol state university.

**Keywords:** laboratory practice, remote mode, network equipment, ping, tracert

UDC 004.93'1

## **VISUAL RECOGNITION OF RECORDS IN THE EXAMINATION SHEETS**

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### **Introduction**

Pattern recognition can be defined as the assignment of observed data to a specific class based on the identification of the essential features characterizing this data [1].

One of the common approaches to pattern recognition is the use of trained models of artificial neural networks (ANNs). ANNs training consists in modifying the neuron link weights.

In this paper, the authors consider the task of visual recognition of records in the examination sheets used in universities.

The scanned image of the sheet is fed to the input of the recognition system. The main part of the statement is a table containing columns that can be divided into 6 categories:

- printed text containing only numbers;
- printed text containing characters of the Russian alphabet;
- handwritten text containing only numbers;
- handwritten text containing only one character of the Latin alphabet;
- handwritten text containing characters of the Russian alphabet;
- handwritten signature of the teacher.

Therefore, the data contained in the examination sheet are heterogeneous and it was more expedient to decompose the task into

specific subtasks. That is, for each category of records in the table creates particular classifier. It should be noted, that in the current work the task of recognizing the signature of the teacher is not considered.

### **Main part**

The paramount task is to localize the location of the main table of the statements and extract data. To solve this problem, it can apply the known methods of data preprocessing, for example, morphological operations. In paper [2], morphological operations are first applied to a previously transformed binary image in order to find vertical and horizontal lines, and then the contours of the desired objects are detected.

The extracted data from the main table will represent the input for a specific classifier.

Visual recognition of both handwritten and printed characters can be reduced to the following steps [3]:

- image preprocessing;
- segmentation characters;
- feature extraction;
- classification.

As noted above, one of the most effective recognition tools is ANN. Today, there are a large number of different models of neural networks for character recognition.

To solve the problem of recognition of printed text, LSTM networks are well used [4]. In that article, the author compares the effectiveness of the proposed method with then existing computer vision systems, for example, Tesseract. LSTM networks are a kind of recurrent neural networks with long-term short-term memory, which allow solving problems of context-oriented processing [5].

The recognition of printed numbers can be solved using LSTM networks, which are supplemented by segmentation methods based on morphological operations and contour finding algorithms with the subsequent use of convolutional neural networks (CNN). To recognize handwritten numbers can be used the approach described by Y. Lekun [6].

Recognition of handwritten characters of the Latin alphabet and recognition of handwritten text containing characters of the Russian alphabet can be implemented using the same approach proposed in [6]. The small number of recognized classes explains this: in the case of the Latin alphabet - seven classes, in the case of the Russian alphabet - seven classes.

To solve the problem of recognizing handwritten characters representing numbers, the approach described in [7] can be applied. Since the input data is an image of handwritten numbers that can have connecting elements between each other, the problem of segmentation into individual

numbers and their subsequent recognition is complex and today does not have a single approach to solving. In this regard, in [7] applies the classification of characters free segmentation. The main feature of the approach is the use of several classifiers: the classifier to recognize the length of a sequence of characters (1, 2 or 3 digits) and the classifiers to recognize a number of a specific length (for example, a classifier for a two-digit or three-digit number). The accuracy of this approach is about 99% for the length classifier, and for classifiers of numbers of a specific length - about 98% on synthetic test data.

In conclusion, it should be noted that for the considered recognition methods, it is important to have data for training and testing classifier models. For handwritten characters of the Latin alphabet, it is possible to use the NIST Special Database 19 [8], for handwritten numbers - Touching Digits Synthetic Data [9, 10]. For handwritten text of the Russian alphabet, it would be more expedient to form our own database because of the specifics of the task at hand - a small number of classes for recognition. For printed characters, there is no problem with the formation of the training set.

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**Аннотация.** В статье рассматривается задача визуального распознавания записей в экзаменационной ведомости. Проводится декомпозиция исходной задачи на составляющие. Рассматривается общий подход для решения каждой подзадачи. Анализируются методы искусственного интеллекта для конкретных подзадач. В заключение отмечается важность набора тренировочных данных для рассмотренных методов.

**Ключевые слова:** визуальное распознавание образов, искусственные нейронные сети, экзаменационная ведомость, печатные символы, рукописные символы, LSTM, CNN, обучающее множество.

**Annotation.** The article addresses the problem of visual recognition of records in the examination sheet. The initial problem is decomposed into its components. Considers a general approach to solving each subtasks. Analyzes the methods of artificial intelligence of visual recognition for specific sub-tasks. In conclusion, notes the importance of a set of training data for the considered methods.

**Keywords:** visual pattern recognition, artificial neural networks, examination sheet, printed characters, handwritten characters, LSTM, CNN, training set.

UDC 528

## LASER SCANNING AND PHOTOGRAMMETRY METHODS FOR A LANDSLIDE 3D MODELING

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The relevance of the study of landslides is due to the fact that the consequences of landslide processes can cause a significant threat to both humans and infrastructure. Therefore, there is a need to develop timely plans for engineering protection of objects, as well as to carry out the necessary preliminary measures, including monitoring, for optimal prediction of the development of negative landslide processes and their prevention or timely reduction of the consequences, which will reduce possible risks and reduce material damage.

Various methods are used to monitor landslide processes abroad. For example, creating a digital terrain model. The author Mustafa Ridha of Masaala considers «An improved algorithm for identifying shallow and deep-seated landslides in dense tropical forest from airborne laser scanning data» in his article. He notes that Cameron Highlands in Malaysia has been frequently affected due to geo-hazards such as landslides and floods. Landslide as one of the geo-hazards is considered as a geological phenomenon under the influence of gravity, which can occur in both onshore, offshore, and coastal environment [1]. Cameron Highlands have a steep hillside landscape with heavy vegetation cover that obscures and subdues morphologic features which are indicative of landslides. Such landscapes cause a great challenge to landslides identification using synthetic aperture radar (SAR) images, optical and aerial photographs, high spatial resolution multispectral images, very high resolution (VHR) satellite images and moderate resolution digital terrain models (DTMs).

Compared with the traditional techniques, elevation data are acquired rapidly and accurately using active laser transmitters and receivers light-detection and ranging (LiDAR) data. Generally, LiDAR can penetrate dense vegetation making it a better alternative compared with other remote sensing data. Ground surface and useful information about topographic features are provided using High-resolution LiDAR-derived DEM even in landslides covered under dense vegetation. Furthermore, LiDAR imagery is capable revealing present and historic landslides and its effectiveness/ vulnerability in mapping naked slopes that are formed primarily by landslides. Based on the depth of the surface rupture and movement features, landslides can be classified as deep-seated or shallow.

The LiDAR point cloud data was taken on January 15, 2015, over the proposed area (26.7km<sup>2</sup>) of the Ringlet around Cameron Highlands an altitude of 1510m. The point density and the pulse rate frequency for the LiDAR data is 8 points per square meter and 25,000Hz, respectively. The

absolute accuracy of the LiDAR data was restricted to the root-mean-square errors of 0.3 and 0.15m as standardized by Department of Survey and Mapping Malaysia (JUPEM) for the horizontal and vertical axes, respectively. A similar approach for the acquisition of LiDAR point cloud data was adopted to collect the orthophotos. A DEM with 0.5m spatial resolution was interpolated from the LiDAR point clouds after the non-ground points were removed using inverse distance weighting, with GDM2000/Peninsula RSO as the spatial reference. Subsequently, the identification of the characteristics and location of the landslides was facilitated with theaid derived layers which were generated using LiDAR-based DEM. One of the significant factors that affect land stability is the slope and this is due to its direct impact on landslide phenomenology. The slope is also considered as a principal factor that affects landslide occurrences. Landslide mapping can be facilitated by hill shade map which indicates relative slope and provides a good image showing terrain movement. It is important to note that texture features and geometric feature are significant in improving the classification accuracy of landslide mapping. Recently it was shown that, the intensity feature derived from LiDAR point cloud is highly effective toward differentiating between the landslide and other classes of land cover. The accuracy of DEM and its capability to represent the surface are affected by interpolation algorithm in addition to sampling density and terrain morphology. shows the features identified from LiDAR data. They include hillshade, intensity, height (nDSM), slope, and aspect. Others are orthophotos, and texture based features.

In the paper «The Use of Gigapixel Photogrammetry for the Understanding of Landslide Processes in Alpine Terrain», author Saverio Romeo notes that the research was carried out by coupling two different photogrammetric techniques and a semi-automatic method for rock mass characterization: Gigapixel photogrammetry [2]. Moreover, data from photogrammetric techniques were compared and integrated with those from a GBInSAR monitoring campaign developed during 2013–2014. Ground-based synthetic aperture radar interferometry (GBInSAR) is a radar-based technique successfully employed to detect the evolution of natural processes such as landslides, volcanic activity, and dynamics of glaciers and snow-covered slopes. This technology allows two-dimensional (2D) displacement maps of a wide scenario (i.e., few square kilometers) with metric or submetric resolution, submillimeter accuracy and sampling frequency of few minutes to be produced [3]. GBInSAR was placed at the base of the slope, about 1.2 km away from the Head Area: it is an active microwave acquisition sensor that provides its own illumination and measures the reflected signal (temporal resolution of 5 min). GBInSAR provides a remotely sensed

measurement of ground displacements, with sub-millimeter accuracy, and is able to supply a deformation map of the slope, without the need for positioning targets on the ground and without any physical contact with the slope.

Product Gigapan was created in 2008 by a research collaboration between NASA and Carnegie Mellon University, to develop a very high-resolution imaging technique for use in the Mars Exploration Rover mission. Essentially, the Gigapan system acquires in sequence – by using a robotic head – hundreds of images partially overlapping, avoiding parallax errors. Thanks to a proper stitching of images, the reconstruction of an exceptionally detailed 2D Gigapixel image is possible.

Gigapan's products can be used in geological mapping as an extremely useful tool for documenting, detecting, and evaluating geological features such as landslides.

Although this method has many advantages (short installation time, low cost instrument, and fast acquisition), compared with other images sources – such as Unmanned Aerial Vehicle (UAV) – it shows some disadvantages as the presence of shaded areas in the acquired images, due to its ground-based nature.

With the aim of creating a 3D representation, high-resolution digital photos were collected from different positions. The 3D model was georeferenced using GPS coordinates associated with camera locations and Ground Control Points (GCPs) along the slope. In the case of Ingelsberg, the Gigapan survey was carried out on May 2016 using four observation points located at about 1000 m distance from the landslide slope. A Nikon D800 with a 400 mm lens camera were used. The images were acquired in raw format at the maximum available resolution of 36.3 Megapixel: every single image was composed of 7360×4912 pixels on a FF (Full Frame) sensor of 35.9×24 mm size. Therefore, the pixel size on the sensor was 0.00488 mm. The camera's sensitivity was set up at 400 ISO (International Organization of Standard); with the available light (a sunny day at the end of May 2016, at about noon) the shutter speed was set at 1/800 s and the aperture at f/5.6. The images were then converted and saved in TIFF format with no compression, to preserve the original resolution and quality. The image-overlapping ratio in horizontal and vertical direction varied from 60% to 80% of the image side.

Having considered the various approaches used to study landslide sites. It can be noted that they have their pros and cons. The best option is to combine several methods to get more detailed information. For example, if the area under study is a mountainous or strongly curved coastline, then aerial laser scanning should be used, as it will be difficult to use photogrammetry. Also, if the terrain does not allow you to use the laser

scanning method due to the banal placement of equipment, it is advisable to use photogrammetry, thereby supplementing the missing data.

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**Аннотация.** Статья посвящена обзору методов создания 3D-моделей применительно к задаче построения модели оползневого участка. В статье анализируются особенности этих методов. Рассмотрены варианты внедрения методов решения задач мониторинга оползней за рубежом. Выявлена и обоснована необходимость совместного использования нескольких методов.

**Ключевые слова:** лазерное сканирование, фотограмметрия, 3D модель, оползень.

**Annotation.** The article is devoted to the review of methods for creating 3D models in relation to the problem of building a model of a landslide site. The article analyzes the features of these methods. Options for implementing methods for solving landslide monitoring problems abroad are considered. The necessity of joint use of several methods is identified and justified.

**Keyword:** laser scanning, photogrammetry, 3D model, landslide.

UDC 004.048

### **MODERN TECHNOLOGIES FOR RECEIVING, TRANSMITTING, STORING AND PROCESSING DATA**

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**Introduction.** One of the most perspective solutions for increasing the level of automation in different spheres of our activity are IoT networks and

technologies, which are “being successfully implemented not only in service business, but also in real sector of economy, e.g. mining and oil & gas industry” [1, www]. Today this theme is relevant in connection with the transition of many institutions to the remote method of work during the period of counteraction to the coronavirus.

Modern technologies for receiving, transmitting, storing and processing data are based on the principles of increasing the speed and volume of transmitted information, and its processing, at a relatively low cost of equipment and services for its implementation.

To ensure high-speed data reception and transmission, various communication channels are used, which can be considered as a system – network.

This transmission occurs at a certain speed, which depends on the operating conditions and the type of channel through which the message is transmitted and received. The main criteria that characterize the transmission channel are:

- operating frequency range;
- maximum transfer speed;
- signal attenuation;
- price.

#### **Main part of the research.**

These parameters largely depend on the technology used for transmitting, receiving, processing and storing information, the development of which is based on the principles of increasing the speed of data transmission, improving processing methods and reducing the cost of equipment and services for their implementation.

“Apart from information transmission, IoT networks are able, in particular, to simplify problem solution for indoor localization and navigation of autonomous mobile objects (users, robotics platforms, etc.)” [1, www].

The set of communication channels used is usually considered as a system which structure has the form of a network. Networks can be represented as sets of levels that are arranged in a hierarchical system from bottom to top. Their number is determined by the specific model used to create the network. Each lower level provides a specific set of services to the higher level by adding its own header to the message structure. The interaction of systems at the same level occurs over a single protocol that describes the rules and conditions for their operation. Currently existing protocols can be divided into the following groups according to the levels of interaction:

- physical layer – modem protocols *V.21... V.92, RS-232, RS-422, RS-423, RS-449, RS-485, ITU-T, xDSL, ISDN, T-carrier (T1, E1)*, modifications

of the standard *Ethernet: 10BASE-T, 10BASE2, 10BASE5, 100BASE-T (100BASE-TX, 100BASE-T4, 100BASE-FX are included), 1000BASE-T, 1000BASE-TX, 1000BASE-SX;*

- canal level – *SLIP, PPP, Ethernet, LLC, X.25, ARCnet, ATM, DTM, SLIP, SMDS, FDDI, Frame Relay, LocalTalk, Token ring, StarLan, Wi-Fi, L2F, L2TP, PPTP, PPPoE, PROFIBUS, STP;*

- net level – gateway protocols *IP, RIP, IPX;* auxiliary *ICMP, IGMP, NWLink, NetBEUI, DDP, IPSec, ARP, RARP, DHCP, BootP, SKIP;*

- transport level – *TCP, UDP, NetBEUI, AEP, ATP, IL, NBP, RTMP, SMB, SPX, SCTP, DCCP, RTP, TFTP, MKKTT X.224;*

- sensor level – *ASP, ADSP, DLC, Named Pipes, NBT, NetBIOS, NWLink, Printer Access Protocol, Zone Information Protocol, SSL, TLS, SOCKS;*

- level of representation – *HTTP, ASN.1, XML-RPC, TDI, XDR, SNMP, FTP, Telnet, SMTP, NCP, AFP;*

- applied level – *HTTP, gopher, Telnet, DNS, SMTP, SNMP, CMIP, FTP, TFTP, SSH, IRC, AIM, NFS, NNTP, NTP, SNTP, XMPP, FTAM, APPC, X.400, X.500, AFP, LDAP, SIP, ITMS, ModbusTCP, BACnetIP, IMAP, POP3, SMB, MFTP, BitTorrent, eD2k, PROFIBUS.*

Control signal transmission protocols are byte-oriented-BSC, for global networks, and bit-oriented-HDLC, for local networks, for example — *NetBIOS, IPX, SPX.*

Currently, wireless data transfer technologies have become widely popular, due to their economic feasibility and high transfer speed. The network equipment is used for this purpose:

- *repeater* – it is used for amplifying, restoring and matching electrical parameters of signals when connecting signal networks;

- *hub* – this is a repeater with multiple Ethernet ports is designed for concentration, processing and further transmission of signals received from various equipment of a separate network with star-shaped technology;

- *switch* – device with multiple processors (multiprocessor) for high-speed independent processing of data signals coming from various ports;

- *router* – a device with multiple processors (multiprocessor) for high-speed independent processing and transmission of data signals between different network segments of various technologies based on rules and routing tables, including heterogeneous networks of different architectures with IP addressing;

- access point (*router*) – a wireless network device that can form a wireless local net that combines multiple devices, such as a switch, modem, DHCP server, and so on.

“Devices of IoT system should provide necessary communication channel capacity for transfer of diverse types of data. Codecs are used for more efficient and fast audio/video data transfer; it’s possible to reduce amount of transmitted data, using codecs” [1, www].

According to the standards of Institute of Electrical and Electronics Engineers (IEEE), wireless data transmitting can be divided:

- *personal*, IEEE 802.15 standard: Bluetooth, IRDA, designed for peripherals at a speed of no more than 2 Mbit / s;

- *local*, IEEE 802.15 standard: Wi-Fi (IEEE 802.11), HiperLAN, that is applied for mobile wired network extensions at speeds up to 54 Mbit / s

- *regional*, IEEE 802.16 at 100 kbit/s, WIMAX at 40-100 Mbit / s, used for data transfer between buildings;

- *global*, *CDPD* standard, Mobile communication systems 2G, 2.5 G, 3G, LTE, for mobile Internet access at various data transfer speeds

**Materials and methods.** For more demanding ultra-long-distance communication, it is necessary to provide that data is received and transmitted with the least external noise input into the communication channel. For this purpose, linear transceivers operating on the LoRa technology at a frequency of 2.4 GHz can be used with the use of adjustable digital PFAT.

Phase frequency auto-tuning (PFAT) is a control system that generates an output signal with a phase associated with the phase of the input signal. The principle of its operation is that during the generation of its own periodic signal, the phase detector compares the phase of this signal with the phase of the input periodic signal, adjusting the generator, thereby matching the phases.

This type of transceiver consumes little power, so their size and power consumption cause a corresponding low cost of batteries for them. It should take into consideration that these modem devices operate at a high data transfer rate, which increases its power consumption and reduces the operating frequency range. In this case, they provide a built-in voltage regulator. In such devices, information is received and transmitted in batch mode in half-duplex mode, that is, while receiving and transmitting at the same time, and can work both in offline mode, regardless of the device where they are installed, and in compatibility mode with the microcontroller. Packet processing depends on the type of transceiver.

In the receiving mode, the bit data stream is collected, restored, decoded, and stored in the buffer and the required packet is formed and sent to the modulator for subsequent transmission in the transfer mode. Several types of packages can be placed in one such device, for example:

- GFSK system;

- Bluetooth Low Energy;
- Fast Long Range Communication;
- LoRa.

*GFSK system* operates with *FSK modulation*, in low-power communication lines, with encoding based on the principle of *No-Return-to-Zero (NRZ)*. Data packets can be transmitted in two ways, with *Fixed-length Packet*, and *Variable-length Packet*. Since data packets with a fixed length cannot be transmitted over a wireless communication channel, the packet length is formed by the packetLength command with a length from 0 to 255 bytes.

*Bluetooth Low Energy* uses *FHSS – Frequency Hopping Spread Spectrum* method in 2.4-2.4835 GHz band. This method differs in that it rapidly changes the carrier frequency in a large frequency band of the spectrum. In this case, the carrier frequency is divided into 79 working bands with a width of 1 MHz, and changes at a speed of 1600 times per second in a pseudo-random manner. This switching is controlled by a code known only to the sender and recipient, which is reset every 625 microseconds. “The Bluetooth 4.0 technology is able to provide transmission of text data packages with low energy consumption, but its bitrate and bandwidth are not enough for audio/video data transfer” [1, www].

This method of transmission is very convenient for communication channels with multiple access and code division (CDMA), and because it has a good interference and hacking protection of the transmission channel.

Transmitting velocity depends on specifications:

- 1.0,1.1,1.2-64 kbit / s, 1 Mbit / s;
- 2.0,2.1-2...3 Mbit / s;
- 3.0;4.0-24 Mbit / s;.

*FLRC* package consists of the following elements:

- AGC preamble of variable length, which can reach up to 1 byte, at a data transfer rate of 1.3 Mbit / s, at other speeds, the increment step must be at least 2 bytes;
- Sync recovery consisting of a 21-bit preamble that can contain an AGC preamble up to 4 bytes long;
- The synchronization word is 32 bits, of which 31 bits can be configured;
- Payload from 6 to 127 bytes; a CRC Field consisting of 2, 3, or 4 bytes;
- A 6-bit sequence of zeros.

The variable-length packet format is similar to the fixed-length format, but with a fixed-structure header with a 2-bit ad executed in CRC and convolutional encoding followed by a payload.

*ZigBee* – low-cost, low-power technology of the IEEE 802.15.4 standard, designed to use high-level communication protocols used in creating networks with low-power battery-powered digital transceivers in wireless management and monitoring applications. ZigBee chips are usually integrated into transceivers and provide low-latency communication.

**Bandwidth**

- 868.0-868.6 MHz (Europe, one channel is permitted);
- 902.0-928.0 MHz (North America – 10 channels – 10 channels (2003), 30 channels (2006));
- 2400-2483.5 MHz (Russia);

The transfer rate depends on the specification:

- 250 kbit/ s, 100 kbit/ s, 40 kbit/ s, and 20 kbit/ s.

*Piconet* – a peer-to-peer network for a high-speed, short-range wireless environment (picaset) that uses a Bluetooth connection can connect up to seven devices to the main device, and up to 255 additional subordinate inactive devices.

**Transmitting velocity:**

11...55 Mbit (5 allowable speeds).

*LoRa (Long Range)* – this is an extended spectrum modulation method based on the *Chirp spread spectrum* (CSS) technology. LoRa is a low-power wireless radio frequency technology used for Internet of things (IoT) networks. Devices based on LoRa technology and the open LoRaWAN protocol allow to use intelligent IoT applications of energy management, natural resource reduction, pollution control. The use of this technology can increase the efficiency of infrastructure in creating smart cities, homes and buildings, intelligent agriculture, intelligent inventory accounting in enterprises, intelligent supply chain and logistics.

*LoRaWAN* – this is a low-power wide area network (LPWAN) protocol based on *LoRa* technology, designed to wirelessly connect devices powered by autonomous power sources to the Internet in regional, national, or global networks. This protocol uses unlicensed radio frequency spectrum that is used in the industrial, scientific, and medical fields (ISM).

**Results.** These data transfer technologies can be used when producing:

- Artificial intelligence (AI), which is the most promising technical achievement of our time, used in various fields of human activity to improve the quality of life and optimize the operation of enterprises.
- 5G mobile data networks at ultra-fast speeds, which allows to implement programs to create the Internet of things (IoT) and Artificial intelligence;

- autonomous vehicle (AV) that can analyze the environment and use the information of GPS, GLONASS system etc., and as a result, they can transfer safely without human activity;
- personalized and predictive medicine systems that can collect and process data from human-wearable sensors and use them to accurately diagnose and predict the course of disease.

**Conclusion.** In this research the main method of data transmission were analyzed. The parameters of network devices, necessary to provide this process, are found. It was stated that Frequency Hopping Spread Spectrum method of transmission is very convenient one for communication channels with multiple access and code division (CDMA). High-speed data transfer from mobile networks is convenient devices application both at home and businesses. The data transfer technologies can be used when producing Artificial intelligence, in personalized and predictive medicine, as 5G data networks and self-driving car with autonomous control.

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**Аннотация.** На основе основных критериев, характеризующих канал передачи, были описаны технологии беспроводной передачи данных. Проанализировано сетевое оборудование. Рассмотрены некоторые способы передачи данных, их преимущества и недостатки.

**Ключевые слова:** прием, передача, хранение и обработка данных, ретранслятор, концентратор, коммутатор, роутер, мобильные сети.

**Annotation.** Based on the main criteria that characterize the transmission channel the wireless data transfer technologies have been stated. The network equipment was analyzed. Some methods of data transmission, their advantages and disadvantages were considered.

**Keywords:** receiving, transmitting, storing and processing data, repeater, hub, switch, router, mobile networks.

**APPLICATIONS OF SWARM INTELLIGENCE FOR SOLVING  
PROBLEMS OF REMOTE SENSING OF THE EARTH**

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**Introduction.** Suppose that "intelligence is the ability of a system to create, in the course of self-learning, programs for solving problems of any complexity and to solve these problems". In the theory of artificial intelligence for a particular problem, several intelligent systems will be created using the necessary resources to solve the problem.

Systems of swarm intelligence (SI) consist of many agents which are connected locally and interact with each other [2]. Such SI behavior comes from nature. There are many reasons based on the Swarm intelligence, which are the most important. These are flexibility and versatility [3]. Swarm intelligence is used in solving non-linear problems of design, data mining, technology and industry, monitoring and control of objects, as well as possible applications of remote sensing of the Earth: environmental monitoring of the sea, detection of oil pollution, study of vegetation and soil.

**The main part.** Some scientists [1] describe the study of a special protected natural area using UAVs. They considered the main problems in a specially protected natural area, namely a lesion of the forest and dead wood.

To cover the entire territory of the reserve, it took three flights in 2 days, while there were extreme weather conditions. It is advisable to use several UAVs to study the forest. The performance of the complex of unmanned aerial vehicles will reduce the duration of the flight and the number of take-offs, especially taking into account weather conditions.

The aim of this work is to analyze swarm intelligence algorithms for the application of remote sensing tasks. In the process, the variant analysis of the identified alternatives that were used for comparison, represent different algorithms of swarm intelligence, such as: based on a flock of "bees",

"fireflies", "wolves" and "lions". It was revealed that the swarm algorithm of application in expert systems oriented to agriculture, plant, soil territories is pursued. The result is a tabular comparison of satellite images and aerial photographs. The criteria importance is estimated. It was revealed that swarm algorithm of application in expert systems oriented to agriculture, plant, soil territories. The simulation of the intelligent Swarm system is implemented. In accordance with the data analyzed, it is most suitable to use several drones, since solving specific problems of remote sensing data using swarm intelligence and a model confirms their high efficiency and minimize errors.

**The results** of studies using swarm intelligence, made a variant analysis, assess the importance of the criteria and compare satellite images and aerial photographs. The study showed that it is significant to use several unmanned aerial vehicles and the reference point method, because the UAV provides more data than one unmanned aerial vehicle, while the accuracy of the images is higher.

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**Аннотация.** В данной работе проводится обзор, алгоритмов и методов роевого интеллекта. Проанализированы алгоритмы роевого интеллекта, чтобы решить конкретные задачи ДЗЗ. Рассматриваются их применения в различных отраслях: сельском хозяйстве, лесоводстве, охране окружающей среды, планировке территорий, гидрологических исследованиях и других целях.

**Ключевые слова:** данные дистанционного зондирования Земли, искусственный интеллект, роевой интеллект, беспилотный летательный аппарат, лесные массивы.

**Annotation.** In this paper, we review the algorithms and methods of swarm intelligence. Swarm intelligence algorithms to solve specific remote sensing tasks are analyzed in detail. Their applications in following sectors

are considered: agriculture, forestry, environmental protection, territory planning, hydrological research and other purposes.

**Keywords:** Earth remote sensing data, artificial intelligence, re-intelligence, unmanned aerial vehicle, swarm intelligence.

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## **CONCEPT OF DECENTRALIZED DATA STORAGE APPLIED ON ANDROID OS: OVERVIEW OF METHODS**

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### **Introduction**

Decentralized systems[1] are becoming the ground for a large number of systems due to their innovation and efficiency.

It provides a high level of security for data transition and storage as the information about the entire transaction history is stored by each party, therefore the system cannot be deceived or destroyed. Each transaction is automatically confirmed by several independent nodes (nodes), which makes it impossible to substitute data or commit forgery.

However, nowadays more users own a smartphone instead of a PC and there are numerous attempts to apply this technology for Android [2] and iOS smartphones. Android OS can use several blockchain-based APIs, to form a decentralized system depending on 3rd party service, that can be shut down at any moment. Thus the best decision is to communicate between devices by some P2P[3] approach using only hardware modules or internet connection.

There are different kinds of P2P connections, these are:

1. Bluetooth (BLE) [3];
2. Wi-Fi (Wi-Fi Ad-hoc) [4];
3. NanoHttpd [5];
4. Nearby Connections [6];
5. OpenDHT [7].

They differ by many features such as operation range, exchange speed and connection durability.

It's always necessary to consider the main usability features in order to provide decent experience to every user.

### **Main part**

The main goal of the following paragraphs is to give definition to the P2P connection type mentioned above and determine most suitable practical appliances for each one of them.

Bluetooth technology functions by means of radio waves transmission in the ISM (Industry, Science and Medicine) frequency band.

Modern smartphones are equipped with a Bluetooth-transmitter of a certain generation. This allows to set a simple P2P connection between 2 devices i.e. another smartphone, PC and a variety of devices like wireless headset and smart home appliance within limited range (15-20 meters). Consequently, Bluetooth P2P system will allow to set single-channel energy efficient connection within a limited area. However, this kind of connection lacks reliability as the connection can be disrupted by operational frequency overload or increased distance between devices. Another issue is sufficiently low security as there is a number of solutions that can track and decode all active Bluetooth channels.

Given the above, Bluetooth P2P connection is best applied to connect two devices with minimal charge consumption but is not suitable to transfer sensitive data.

Wi-Fi (Wireless Fidelity) is a network structure that contains at least one access point and at least one client. It is possible to connect two clients in point-to-point (Ad-hoc) mode, when the access point is not used, and the clients are connected via network adapters.

Wi-Fi networks have become an ordinary technology that provides wireless internet connection two decades ago and has gained multiple appliances since. Nowadays Wi-Fi is widely used in Manufacture, Healthcare, Finance, Corporate, Security and other fields providing continuous data access.

Wi-Fi can assure decent safety for sensitive data by means of various firewalls and encryption as well as provide fast exchange. Operational range of Wi-Fi network can be from a few dozen meters up to 1-2 kilometers. This creates opportunities to create P2P networks of various purposes starting from decentralized data exchange up to IoT networks (smart home, automated manufacture, etc.)

However, there are a few disadvantages of Wi-Fi appliance. Specialized equipment is required to increase operational radius and enhance signal. Firewall protection can be breached and sensitive data can be damaged or stolen. And Wi-Fi mostly uses the same ISM band (2.4 GHz) as Bluetooth devices and even some home appliances like microwave oven.

To improve Bluetooth and Wi-Fi technologies and to ease developers building reliable systems was created Nearby Connections(NC) by Google. It

is a peer-to-peer networking API that allows apps to easily discover, connect to, and exchange data with nearby devices in real-time, regardless of network connectivity. NC enables advertising, discovery, and connections between nearby devices in a fully-offline peer-to-peer manner. Connections between devices are high-bandwidth, low-latency, and fully encrypted to enable fast, secure data transfers. Under the hood, the API uses a combination of Bluetooth, BLE, and Wifi hotspots, leveraging the strengths of each while circumventing their respective weaknesses.

NanoHttpd is an open-source, small-footprint web server that is suitable for embedding in applications, written in the Java programming language.

This technology allows to implement own client-server architecture[8], when any device in system at the same time should be a client and a server with some REST API.

The main advantage of this approach is ability to take actual client-server solution and transfer it to mobile.

On the other hand, there are a few disadvantages such as: the server should continuously run in the background and it has to belong to any local network or VPN. Also it won't be able to handle internet connection, because it doesn't have a static IP-address and it's complicated to refresh the system on every update. A primary goal of this API is to assure simple and reliable performance for the platform.

OpenDHT - most distinctive and innovative characteristic is the fact that it doesn't require a server to relay data between users. There are many advantages associated with that, including increased privacy, light infrastructure, high scalability, no bandwidth restriction (other than that of your Internet connection), no size limit for file transfers, and more. But while servers are not required, they are still used in five specific cases: push notifications, the OpenDHT proxy, bootstrap, name server, and TURN.

In conclusion it should be noted that it's possible to build decentralized systems for various purposes using P2P.

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**Аннотация.** В статье рассматривается задача децентрализованного хранения данных на базе ОС Android. Проводится сравнительный анализ способов реализации данной технологии, рассматриваются сферы применения и ограничения при использовании. В заключение отмечается важность набора необходимой технологии исходя из потребностей разрабатываемой системы и ограничений на ее разработку.

**Ключевые слова:** децентрализованная система, P2P, Android ОС, Bluetooth, Wi-Fi, NanoHttpd, Nearby Connections, OpenDHT.

**Annotation.** The article covers the problem of decentralized data storage based on the Android OS. A comparative analysis of ways to implement this technology is conducted, the scope of application and limitations of its use are considered. In conclusion it is important to set the necessary technology based on the needs of the system being developed and the limitations on its development.

**Keywords:** decentralized system, P2P, Android OS, Bluetooth, Wi-Fi, NanoHttpd, Nearby Connections, OpenDHT.

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## **EXAMPLE OF USE THE PYTHON PROGRAMMING LANGUAGE IN A MACHINE LEARNING TASK**

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## Introduction

Machine Learning (ML) — is a technology whose main objective is self-learning by solving a large number of similar tasks. This is achieved by providing the machine with input information, which it uses to predict further results.

The article considers an example of solving one of the main tasks ML — finding the dependence of a variable on several regressors based on the use of an interpreted object-oriented programming language Python [3].

## Main part

Machine learning suggests many statistical, computational and mathematical methods to develop algorithms that can solve the problem based on the search for patterns. The solution is calculated not according to a clear formula, but according to the established dependence of the results on a specific set of characteristics and their values [2].

In machine learning, the following main tasks are highlighted:

- regression – search for dependencies of output values on input;
- classification – prediction to which of the known classes the object belongs;
- clustering – separation of a large number of objects into clusters – classes within which objects are similar to each other;
- dimension reduction – reducing a large number of features to a smaller one (usually 2-3) for the convenience of visualizing them (for example, data compression);
- identification of anomalies — the search for rare and unusual objects that differ significantly from the mass.

Consider the machine learning option in the regression problem. Necessary using known input and output data find patterns and apply them to the next incoming data. Information for the primary processing is presented in table 1. Examples 1-4 are used to train the machine, and X in the test example is the desired value that the machine should determine after training. Having carefully studied the examples, the following patterns can be observed: the result is a value (0 or 1), which is more likely.

Table 1 — The source data for training

Examples	Input data			Result
1	0	0	1	0
2	1	1	1	1
3	1	0	1	1
4	0	1	1	1
Checking	0	0	1	X

To implement this task, was chosen an interpreted object-oriented Python programming language because of its ease of development, efficient high-level data structure and a large number of libraries. The result of the program is displayed on (Fig. 1). Knowing the pattern, can check the correctness of the training. Since  $X$  must be equal to or tend to zero, the result of the check example is determined correctly.

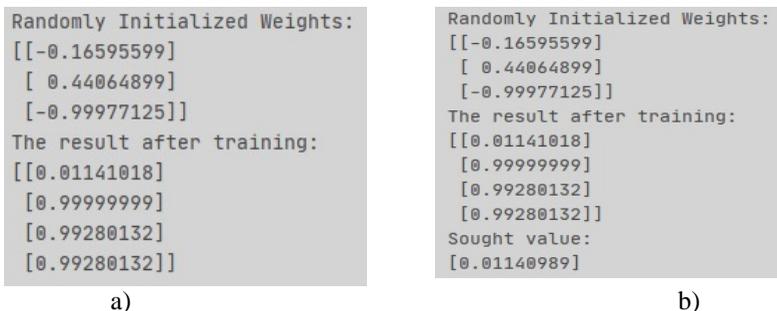


Figure 1 — Data obtained after calculation: data indicated for training (a), and data taking into account the verified example (b)

The example used a library to construct multidimensional arrays and matrices NumPy.

Please note that ML conducts testing in accordance with the black box strategy. The "black box" refers to the system, about the internal organization of behavior of which there is no information, but there is the possibility of influencing its inputs and perceive the responses at its outputs. That is, the studied system is considered not as a set of interacting elements, but as a single whole interacting with the environment at its inputs and outputs [1].

### Conclusion

An example of machine learning using the Python language is considered. Its main advantages over other programming languages are minimalism and compactness. For example, this program would fit in 17 logical lines, while JavaScript would take 25 lines. This advantage is especially noticeable when need to work with large amounts of data. In addition, it should be noted such advantages of the Python language as a large selection of libraries and porting.

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**Аннотация.** В статье продемонстрирован пример использования языка Python в машинном обучении и его преимущества в этой области по сравнению с другими языками программирования.

Отмечается, что в машинном обучении тестирование осуществляется в соответствии со стратегией «черного ящика», которая подразумевает, что изучаемая система представляет собой единое целое, взаимодействующее со средой на своих входах и выходах.

**Ключевые слова:** машинное обучение, Python, регрессия, черный ящик.

**Annotation.** The article shows an example of the use of the Python language in machine learning and its advantages in this area compared to other programming languages.

It is noted that in machine learning, testing is carried out in accordance with the “black box” strategy, which implies that the system under study is a single whole that interacts with the environment at its inputs and outputs.

**Key words:** machine learning, Python, regression, black box.

UDC 004

## **BASES OF CONSENSUS ALGORITHMS**

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In the modern world, one of the problems is the authenticity of data in the information systems and technologies. Over time, distributed data storage technologies have appeared where all data is stored in a decentralized manner and have full replication on nodes and data encryption. Implementing such a registry, the question arises to which distributed registry strategy to choose and use.

Distributed registries differ in the way decisions are agreed, such algorithms are called consensus algorithms. These are methods of solving the problem of the Byzantine Generals. The problem of the Byzantine Generals

is a possible one with communication which is allowed while making a decision. If some of the generals sends inaccurate information, then a decision must be made to trust this information, so all generals must agree with a single decision. This task is also applicable to distributed registries, as there are many nodes in the blockchain network that must confirm or deny the authenticity of the created blocks. For this, consensus algorithms are implemented [1-5].

In our study, consensus algorithms are considered, also a comparative analysis between them has been carried out. The study revealed that the Proof-of-Work algorithm is more energy-consuming than the other algorithms examined, but it eliminates network attacks. Proof-of-Work assumes that miners compute a one-time value in unlimited space.

The next covered algorithm considered was the Proof-of-Stake algorithm, which is an energy-efficient alternative to the Proof-of-Work strategy. Its difference is that the strategy does not require users to search value in unlimited space, but it requires people to prove their possession of the amount of currency, since it is believed that a richer miner will less likely attack the network.

The result of optimizing the two Proof-of-Stake and Proof-of-Work strategies is the new Proof-of-Activity strategy. Proof-of-Activity is a strategy based on solving a problem similar to the Proof-of-Work strategy, but with significantly reduced computational complexity, so it takes a fraction from a second to several minutes to solve a problem. It is worth noting here that the Proof-of-Work strategy calculates one block in about ten minutes.

The algorithm requires a small amount of computing resources compared to Proof-of-Work. Checking the correctness of the created blocks is performed by limiting the minimum possible time to create a block. This allows people limit the maximum speed of adding blocks to the blockchain.

An alternative algorithm is Proof-of-Capacity. The Proof-of-Capacity strategy emerged as one of the possible solutions to the problem of high energy consumption using the Proof-of-Work algorithm and a situation in which it is more profitable for miners to save cryptocurrency rather than spend it, as in the case with the Proof-of-State strategy. While using the PoW algorithm, miners at maximum speed change the numerical parameter in the block header, in an attempt to find the desired block hash. The first miner to find is the desired hash value, or nonce, distributes information over the network. The remaining miners confirm the transaction and proceed to work on the next block.

Proof-of-Capacity allows nodes on the blockchain network to use the free space on the hard disk to mine available cryptocurrencies. Instead of

constantly finding through the numerical parameters in the block header and re-hashing, the Proof-of-Capacity strategy creates a list of possible solutions on the miner's hard disk even before mining. The more memory the hard drive has, the more possible solutions can be stored on it. This process increases the chances of the miner to find the desired hash value in its list and get a reward for the calculated block.

A more robust consensus algorithm is Practical-byzantine-fault-tolerance. Practical-byzantine-fault-tolerance (PBFT) is a consensus algorithm of practical Byzantine error tolerance that is responsible for efficient operation in asynchronous networks. The algorithm was created by Barbara Liskov and Miguel Castro in 1999. The aim of the developers was to create a mechanism that solved the problems of fault tolerance of existing solutions based on the Byzantine stability algorithm. Thus, the basis for the algorithm was the already existing BFT mechanism, which allowed consensus to be reached. Even if some nodes in the network do not respond or give incorrect information. The scope of the algorithm includes distributed computing in blockchain networks.

The algorithm is as follows - a new block is determined in a round, after which a primary block is selected in accordance with some rules. The whole process can be divided into three stages:

- pre-prepared;
- prepared;
- required.

The study also examined the Delegated-proof-of-stake strategy. Delegated-proof-of-stake (DPOS) – is a strategy in which, as in the case of Proof-of-Stake, miners get priority when creating blocks in accordance with their rate. The main difference between Proof-of-Stake and Delegated-proof-of-stake is that Proof-of-Stake is a direct democracy and DPOS is a representative democracy.

Stakeholders select their delegates to create and validate the block. It was possible to quickly confirm the block with a significantly smaller number of nodes for checking blocks, which made it possible to quickly confirm transactions.

In addition to the Proof-of-Work modification algorithms, the Ripple strategy was also studied. Moreover, it uses collectively trusted subnets in a larger network.

After analyzing the consensus strategies, a comparison was made according to the given criteria.

To sum up, a study of distributed registries was conducted and a brief comparison was made of them according to some specific criteria. Based on the research, we can conclude that there are a sufficient number of

modifications of the Proof-of-Work algorithms and alternatives at the moment. As a rule, The Proof-of-work algorithm, is used mainly only in bitcoin, the rest of the cryptosystems use less consuming consensus strategies for electricity.

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**Аннотация.** Существует множество алгоритмов распределенных реестров. Задача выбора лучшего алгоритма заключается в рассмотрении алгоритмов и определении критериев сравнения. После этого предполагается произвести сравнение набора алгоритмов по определенным критериям. Результатом сравнения должна стать рекомендация по использованию алгоритмов распределенного реестра. В рамках доклада происходит рассмотрение общих основ распределенных реестров. Вводится понятие технологии блокчейн, роли распределенных реестров в области ИТ. В докладе рассматривается алгоритм консенсуса и следующие его варианты:

1. Proof of Work
2. Proof of Stake
3. Delegated Proof-of Stake (DPoS)
4. PoI (Proof-ofImportance)
5. Hybrid PoS/PoW / Гибридный PoS/PoW
6. Byzantine fault tolerance (BFT), Byzantine generals problem
7. PBFT

**Ключевые слова:** Блокчейн, алгоритмы консенсуса, проблема Византийских генералов, анализ алгоритмов.

**Annotation.** There are many distributed ledger algorithms. The task of choosing the best algorithm is to consider the algorithms and determine the comparison criteria. After that, it is supposed to compare the set of algorithms according to certain criteria. The result of the comparison should be a recommendation in the use of distributed registry algorithms. As part of the report, a review of the general framework of distributed registries is underway. The concept of blockchain technology and the role of distributed registries in the field of IT are introduced. The report considers the consensus algorithm and the following options:

1. Proof of Work
2. Proof of Stake
3. Delegated Proof-of Stake (DPoS)
4. PoI (Proof-ofImportance)
5. Hybrid PoS/PoW / Гибридный PoS/PoW
6. Byzantine fault tolerance (BFT), Byzantine generals problem
7. PBFT

**Keywords:** Blockchain, consensus algorithms, the Byzantine generals problem, analyze algorithms.

### SECTION 3: WAR AND VICTORY: PROBLEMS OF PRESERVATION, INTERPRETATION AND TRANSMISSION OF CULTURAL MEMORY OF CULTURAL MEMORY



UDC 37.034

#### HEROES OF MY FAMILY

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*"Death is powerless in the face of human heroic deed "*

*V.P. Vasiliev*

My name is Olga Nikolaevna Barashova. I am a first category methodologist of the Department of Radio Electronics and Telecommunications. I had already left my student age for a long time but when I saw information about the Heroes of My Family project in honor of the 75th anniversary of Victory in the Great Patriotic War with the university's website, I could not resist and was eager to tell you about my valiant ancestors. My both grandfathers took part in the Great Patriotic War, they forged Victory together with all the people of our country. I am very proud of them!

At some point, we think about our roots. We begin to ask relatives about the past of our family. We learn a lot of interesting, unusual, and understand that the history of the family is closely connected with the history of the country.

I would like to begin my story with the words of Nikolai Ostrovsky: "The most precious thing for man is life. It is given to him once, and it is necessary to live so that there is no excruciating pain for the years spent aimlessly, so that shame does not burn for the petty past, and the man, dying,

can say: "All life and all powers were given to the most beautiful thing in the world, to the struggle for the liberation of mankind". It was these life principles that my grandfather guided. His name is Fedor Timofeevich Dolgushev. His fate had not been easy trials.

He was born in a poor peasant large family. He achieved everything in life with hard work and was distinguished by decisiveness, confidence, determination, endurance, ability to bear responsibility, and had a persistent character. These leadership qualities helped him subsequently to become chairman of the collective farm and village council, despite his young age.

The Great Patriotic War began. My grandfather was drafted into the Red Army in March 1943 (87th Guards Red Banner Regiment, 29th Guards Rifle Yelninskaya Red Banner Order of the Suvorov Division, Western Front). He was the commander of the 1st rifle company of the Guards Junior Sergeant's squad. He had performed a heroic deed in August 1943 in the battles for the village of Nadezhda Gnezdilovo-Vskhodsky district of the Smolensk region. My grandfather was the first who stormed into the German trench in front of the village and in a hand-to-hand fight destroyed two German soldiers. He always went ahead and inspired his subordinates by his personal example.

My grandfather had to see a lot of grief and terrible pictures. War, hunger left an indelible mark on his soul. He experienced a lot, but did not lose faith in life and became an example of patience and perseverance. Only to a person who has been close to death, life is revealed by all sides and properties.

When he returned his hair is touched with gray, although at that time he was only 29 years old. He was wounded, he carried the splinter from the bullet in himself until the last days and did not really like to talk about the war, and even more so about his exploit of arms. He was awarded the Order of the Patriotic War of the 1st degree and the medal "For Courage".

Mikhail Ivanovich Elkin was my other father's side grandfather. He was drafted into the Red Army in August 1941 by the Ascension district military Commissariat of the Leningrad Region. My grandfather fought for home and country from the Nazi invaders not for long. His entire team of inexperienced soldiers was ambushed in village and were shot in February 1942.

It was possible to find a mass grave of our dead soldiers only 40 years after the end of the war, thanks to the work of the Obninsky search detachment. Grandfather was buried in the Kaluga region, Iznoskovsky district, the village of Ivanovo. My grandfather Mikhail's personal badge was discovered here. The first letter of the surname was erased from time and poor preservation, but the search guys managed to restore the token, and then they found my father. They told him where the reburial takes place.

Mikhail died without knowing that he had a son — my father, which was the sixth child in the family. My dad had never seen his father and carefully kept the only memory of his father — a crumpled, time-worn photo

card and stories of his mother. My grandmother did not know that her husband was dead, because she received a notification that he was missing at the end of the war.

After so many years, my dad managed to visit the grave of his father. It is probably hard to imagine what feelings were embracing him at that moment. Maybe this desire to protect, protect their family, their land, their Fatherland, their homeland was transferred at the genetic level and that is why my father became a professional military man and carried this title with honor, so to speak, without shaming the memory of his father. Now he is a major reserve.

**We want to save from our ancestors not ashes but fire!**

		
<p><b>Dolgushev Fedor Timofeevich</b>          Date of birth: 06/14/1916.          In the Red Army since March 1943          Date of achievement: 08/10/1943-12/08/1943          Awards: Order of the Patriotic War I degree          and Medal "For Courage"          Award document number: 57.          Date of award document: 01/01/1986.          Record number: 1514705815.</p>	<p><b>Elkin Mikhail Ivanovich</b>          Year of birth 1904          Arrived at part 09/08/1941          Date of disposal 02/12/1942</p>	

Fig.1 — Grandfathers, which took part in the Great Patriotic War

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**Аннотация.** Это рассказ о дедушках автора, которые принимали участие в Великой Отечественной войне, ковали Победу вместе со всем народом. Мы хотим сохранить от наших предков не пепел, а огонь!

**Ключевые слова:** Великая Отечественная война, Победа, подвиг дедушки.

**Annotation.** This is story about grandfathers of author, which took part in the Great Patriotic War, they forged Victory together with all the people of our country. We want to save from our ancestors not ashes but fire!

**Keywords:** Great Patriotic War , Victory, grandfather's heroic deed.

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### **BATTLEFIELD PROVEN SH-40 STRENGTH**

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#### **Introduction.**

The victory in the Great Patriotic War was a consequence of many factors, one of which was the arming of Soviet soldiers. Along with rifles and other weapons, the fighter's kit also included a protective helmet. The helmet was SH-40 used by most Soviet soldiers and became an integral part of the appearance of the Soviet soldier in adaptations of historical events of that period of history, when Soviet soldiers fought the Nazi invaders.

#### **Materials and methods.**

Internet resources were used to collect information for writing the article, providing information about the SH-40 helmet, its characteristics and comparison with analogues.

To begin, the search for information was carried out on encyclopedia sites. They presented information on previous models, the desire to improve which led to the creation of the SH-40 model, the time of its creation. However, no detailed information was provided on the model itself and its comparison with its counterparts.

The next stage was to study forums devoted to military or field-based topics for information on field tests of World War II helmets. On forums and websites aimed at people interested in detailed information on these issues, information was found about the field tests carried out by the Soviet

command of helmets of Soviet soldiers and surviving trophy helmets of German soldiers.

The final stage of the study was the design of all information for addition to the article.

### **Results.**

World War II was very different in the nature of the actions at the front. New types of troops, increasing the manhood of infantry, in view of the rejection of the "trench war" and other conditions required new solutions from military engineers. Including decisions on infantry equipment. The issue of the possibility of using uniforms in various conditions remained important.

An integral part of infantry armament is the protective helmet. Since World War I, the helmets of all warring countries have undergone change, testing and combat use. We will consider one of the variations of the helmets of the soviet soldier, namely the helmet SH-40 (Lysevskaya helmet).

The SH-40 was closely related to the story of using of SH-36, which was developed and adopted in 1936 to replace Adrian 's helmets used still by the Russian imperial army. SH-36 became the first helmet developed and put into mass production in the USSR. SH-36 received baptism of fire during the war in Spain, where it was supplied to Republicans and international brigades [4].

However, in 1938 it was decided to develop a new helmet, later called the SH-39, which had better characteristics [3].

Nevertheless, the SH-39 did not become the final version of the helmet of the Soviet fighter, after all later the legendary SH-40 was adopted. The fact is that the war with Finland showed that SH-39 could not be worn with warm headgear, which increased the risk of frostbite many times.

The design of the SH-40 differs from the previous model used by the sub-device is simpler and stronger. Hence the main external difference: six rivets were used in the SH-40 for attachment of the sub-cluster device, three in the SH-39. The sub-muzzle device consists of three parts - "petals" made of leatherette, imitation leather or fabric which in the top part of a helmet connect the lace intended for adjustment (adjustment) of SH for convenience of carrying. Inside of each lobe there is a cushioning pad made of wool. The tarpaulin chin belt consists of two half parts attached to rings on the sides of the helmet. One of the parts on the free end has a sliding buckle; end of the other half is crimped with a semicircular metal mandrel.

The question, whose equipment is better, concerns not only the soldiers at the front, but also the high command. In 1943, the answer to this question was given by the command of the Soviet Army at the tests of Soviet helmets and trophy helmets of German soldiers.

In December 1942, by order of A. I. Mikoyan, a member of the USSR State Defense Committee, a commission was formed under the leadership of

the Deputy Chief Quartermaster of the Red Army, Major General J. S. Kolesov. Her task was a comparative test of steel helmets of domestic and German production. The commission included representatives of the main quartermaster's department (SIU KA), the People's Commissariat for Ferrous Metallurgy (NKChM) and plant No. 700 of the NKChM, as well as the armored laboratory of the Research Institute No. 13 of the People's Commissariat of Arms (NKV).

The tests took place in two stages: the first took place on January 10–16, 1943 at the dash of the factory No. 700 in Lysva, the second on February 7–12 at the Small Arms Research Center of the Main Artillery Directorate (NIPSVO GAU KA) in Shchurovo, Moscow Region. The SH-40, made of steel grades I-1 and I-2, as well as captured German helmets, were tested.

Unfortunately, the captured German helmets were not sorted by type and all were tested equally, although there was a significant difference between the six different models (M16, M17, M18, M35, M40 and M42). This assumption is made possible by the table-register of the German helmet casings, from which it can be seen that helmets of different sizes were tested, and in the table with the chemical composition of steel determined at Plant No. 700 and NIPSVO and hardness it can be seen that these are helmets of different types. In some places in the table along with the dimensions of the helmets the factory marking is indicated, from which it follows that these were helmets of different factories.

The tests did not imply only the determination of the chemical composition and hardness of the material of the helmets. The most interesting part of them - the shelling and close explosions of ammunition - gave an idea of whose helmet is better.

To shoot at the first stage of testing was supposed from a 7.62 mm Mosin rifle arr. 1891/1930, a cartridge with a reduced charge (designed for a range of 800, 900 and 1000 m) with a bullet mod. 1908, due to the small length of the shooting gallery of plant No. 700 and from the 7.62-mm revolver Nagan arr. 1895 "Nagan" from a distance of 10 m.

At the second stage, at the firing range, they shot a rifle with a full charge of the same bullet at distances of 800, 900 and 1000 m, fired from the PPSH with live ammunition from a distance of 115 m, from a TT from a distance of 65 m. At the end of the tests, 82-mm mortar shells were blown up mines at a distance of two meters [1, 2].

Shelling at the shooting range and at the firing range was carried out on loose helmet casings without a sub-body device from three sides: the frontal, lateral and occipital parts. Why in the dash only hits in a certain area of the helmet were subject, tangent hits, hits closer than 20 mm from the previous one or from a rivet / hole for ventilation were not counted. At the training ground, the requirements for credited hits were softer due to more approximate reality conditions.

According to the results of the study, it was found that the Soviet SSH-40 helmets prevent splinter and bullets from getting better than German helmets.

After conducting a small analysis of sources telling about the uniforms of German soldiers, I concluded that there were several reasons for this. Firstly, Soviet helmets were made of the most durable alloys, the research of which was carried out both in the rear and on the battlefield; the command sought to find a reasonable balance between the price of the helmet and its quality. Secondly, over the course of the war, the new German helmets were made from materials that were cheaper than quality. This is due to the fact that the resources possessed by Hitler Germany were depleted, but Hitler still believed that the end was not as close as everyone suspects, so it was decided to reduce the price of helmets, and accordingly their quality, and channel resources to other industries.

The Wehrmacht soldiers themselves knew the fact that the Soviet helmet is better than the German one. It was common for German soldiers to use the helmets of Soviet soldiers instead of their helmets.

### **Discussion and Conclusions.**

In conclusion, I would like to say that, judging by the tests carried out, the leadership and engineers of the Soviet Union managed to find a balance between the strength of the helmet and its price. The result of the engineers' research was the Soviet steel helmet of 1940, convenient, durable and memorable.

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**Аннотация.** В статье приводятся сведения о советском шлеме СШ-40 и его предшественниках. Также представлены результаты полевых испытаний советских шлемов и захваченных немецких шлемов. Данные, использованные для написания статьи, позволяют определить, почему СШ-40 лучше, чем его немецкие аналоги, и почему немецкие солдаты предпочитали использовать захваченные советские шлемы вместо своих собственных. В статье автор объясняет, почему СШ-40

был лучшим шлемом, используемым на восточном фронте Второй мировой войны.

**Ключевые слова:** каски, БОБ, преимущества, тесты, оборудование.

**Annotation.** The article provides information about the Soviet helmet SH-40 and its predecessors. Also presented are the results of field tests of Soviet helmets and captured German helmets. The data used to write the article makes it possible to determine why the SH-40 is better than its German counterparts are, and why German soldiers preferred to use captured Soviet helmets instead of their own. In the article, the author explains why the SG-40 was the best helmet used on the eastern front of World War II.

**Key words:** helmets, World War II, advantages, tests, equipment.

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## FLYING TANK IL-2

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**Introduction.** Even 75 years after the victory in the great Patriotic war of 1941-1945 y., the memory of it has not faded, the details of military clashes are still being clarified, and the technical means that served as the tools of this war - combat vehicles, aircraft, fleet, and weapons-are being compared. Much of this was later used as a basis for creating new technical devices that work for the benefit of society. The most interesting aircraft to consider are bombers, fighters, and attack aircraft. A striking example of attack aircraft is the world-famous Il-2, which later served as the base for many modern aircraft, such as the Il-62. That's why the aim of this research is to consider the main ways and means of technology of aircraft manufacturing [1, 2].

**Materials and methods.** During this research, some technical documents, articles, reviews and historical aspects were studied, which allowed the author to draw his own conclusions about the development, application and significance of the above-mentioned Il-2 aircraft. A step-by-step history of the development of the Il-2 attack aircraft was given. Thus, general theoretical methods of research of the chosen topic were applied. The conditions and circumstances of production, design features, functional

characteristics, such as weapons, protective qualities, and basic flight characteristics were considered. The statistics of successful combat missions are considered. To form a complete picture, a brief biography of the designer Sergey Vladimirovich Ilyushin was given [5]. The tactical features of the use of this attack aircraft are considered - the attack of ground targets at a low altitude 50 m in the first phase of the fight, as well as the destruction of enemy aircraft at a speed of 300 km/h exceeding its analogues. Some combat maneuvers are considered, for example, the air maneuver "Circle" is considered. Such characteristic features of the Il-2 as similarity with German bombers were noted, which allowed the attack aircraft to be closer to the enemy's positions [4].

**Results.** As a result of the work done, a convenient and open form of information was obtained, containing the main historical, technical and practical information about the Il-2 attack aircraft, aimed at educating and encouraging the listener to independently study the history of the great Patriotic war and military topics. After learning the above things, the listener will be able to compare the Il-2 attack aircraft with other independently studied combat aircraft [3, 6].

**Discussion and Conclusions.** The following statistics were mentioned in the study: during the sorties of casualties among the gunmen were higher than the losses among the pilots of attack aircrafts in 8 times. This information makes it possible to doubt the constructive effectiveness of the Il-2 attack aircraft. The research also mentions that the design of the aircraft was repeatedly corrected, and previously a series of models was released that did not have a compartment for the on-board shooter in the armored cabin. This decision was dictated by the desire to perform the technical task as economically as possible. Despite the presence of armor, without the shooter, this model was vulnerable to enemy attacks. After that, it was decided to place the compartment for the shooter in the cabin. However, this technical solution was also not fully implemented. In order to save money, the shooter's cabin was not armored, which led to the sad statistics: 8 dead shooters per 1 dead attack pilot. Thus, it was concluded that the design of the attack aircraft was far from perfect, which was dictated by the desire to produce a combat model as quickly as possible with minimal costs. Despite this, the Il-2 attack aircraft proved to be an effective combat machine in the theaters of military operations of the great Patriotic war.

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**Аннотация.** Многие слышали о таком оружии Победы, как штурмовик Ил-2, однако человек, далекий от военной темы, вряд ли будет интересоваться историей создания и техническими характеристиками данного штурмовика. Данная работа нацелена на формирование заинтересованности и понимания исторических и технических аспектов орудий Победы. В работе доступно и акцентированно рассмотрены ключевые технические характеристики штурмовика Ил-2, приведена история его создания и краткая биография конструктора Сергея Владимировича Ильюшина. Также рассмотрены наиболее интересные тактические и боевые качества данного штурмовика. Для человека, не связанного с данной темой, вышеизложенной информации вполне достаточно, чтобы иметь базовое представление о штурмовике Ил-2 как о техническом и историческом наследии Советского Союза.

**Ключевые слова:** штурмовик, самолет, война, оружие, авиация.

**Annotation.** Many have heard of such a weapon of Victory as the Il-2 attack aircraft, but a person far from the military topic is unlikely to be interested in the history of the creation and technical characteristics of this attack aircraft. This work is aimed at generating interest and understanding of the historical and technical aspects of Victory tools. In this paper, the key technical characteristics of the Il-2 attack aircraft are considered in an accessible and focused manner, the history of its creation and a brief biography of the designer Sergey Vladimirovich Ilyushin are given. The most interesting tactical and combat qualities of this attack aircraft are also considered. For a person who is not connected with this topic, the above information is quite enough to have a basic idea of the Il-2 attack aircraft as a technical and historical legacy of the Soviet Union.

**Keywords:** attack aircraft, plane, war, weapon, aviation.

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**SEVASTOPOL SCHOOLS DURING GREAT PATRIOTIC WAR  
IN THE BOOK “LIGHT OF UNDERGROUND SCHOOLS” BY  
E.D. KOZITSKAYA-NAYDENOVA**

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**Introduction.** For the first time, the feat of Sevastopol underground schools during the Second World war was described in the book “Light of underground schools” by Ekaterina Kozitskaya-Naydenova.

E.D. Kozitskaya-Naydenova was Sevastopol poetess and she worked at Foreign languages department in Sevastopol State university.

In 1996, she was admitted to the Russian writers' union. Ekaterina Dmitrievna is the winner of the International literary festival of children's writers “Cimmerian muses” in Feodosia, the winner of the incentive award and the author of beautiful prose works (photo 1).



Photo 1 – International Literary Festival.

She is the author of 18 collections of poems, short stories. The first volume of "Roots" includes the story “Light of underground schools”. This is an artistic and documentary narration about an actual events during the Second defense of Sevastopol in 1941-1942 – the underground schools’ activity during 250 days of siege [4].

**Main part.** Before the Great Patriotic War, more than 30 schools worked in Sevastopol. On the 1-st of September, 1941, only 15 schools started working. Two months later, due to increased bombing and shelling, eight schools moved underground. School N. 32, which was located in the

Inkerman tunnels, operated until June 24, 1942 (photo 2). Every day, going to work, the teachers of these schools committed a real feat [2].

They were so selfless and courageous. After all, they fought without weapons! Despite a hunger and hardship, everyone considered as a duty to help the front. When the bombing began, the children were engaged in oral counting. By this way the teachers tried to distract children from terrible bombing.



Photo 2 – Schoolchildren and teachers of underground schools.

Let's give an example of the courage and heroism of teachers and children from this book : “One can say when the guns shoot, the muses are silent. This statement had absolutely nothing to do with the staff of school № 3. They shared the idea that the desire for beauty is an innate feeling of every normal person, which could not be silenced even by nearby exploding bombs... The whole world was notified by Goebels' liars that life was frozen in the besieged Sevastopol, that people are in despondency and melancholy... The youth of the hero city live not with a dull longing, but with a deep confidence in the future free life, with a thirst for knowledge, with love for the Motherland. Nothing will frighten them – neither brutal bombing, no the falling shells” [2, p. 201].

“1942. The lessons stopped in underground schools. Life loves those people who love it. That’s why we are alive. And we gave knowledge our children. There are 2442 students! And they will learn the lessons of courage that no textbooks can teach... We are not only teaching history, but also writing it. You are living witnesses of history, and do not forget: you are Sevastopol residents, ones of a city that never surrenders to the enemy” [2, p. 213].

E.D. Kozitskaya-Naydenova died on February 12, 2014.

“In our computerised, mechanised era, when there is still less and less time for kindness, generosity, charity, even more there is a growing desire to preserve them, to bless them, and to declare them first, the most important lesson in schools, where the processing of the human soul and acquisition of knowledge” [3, p. 15].

**Conclusion.** The processing of the human soul and a formation of spiritual and moral values of youth reach a meaningful fullness when they are connected with life, real social problems that need to be addressed on the basis of a moral choice: for example, to remember the events of a war, respect and honor the memory of the heroes of the Great Patriotic War [3].

“Now, more than ever, you realize that a person remains alive while alive our memory. And the memory of those years is not erased” [1, p. 1]. Remember the words from "Requiem" By R. Rozhdstvensky: “With every second, with every breath, be worthy! People! As long as your heart is pounding, remember!” [1, p. 21].

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**Аннотация.** Впервые подвиг севастопольских подземных школ во время ВОВ был описан в книге Екатерины Дмитриевны Козицкой-Найденовой «Свет подземных школ». На примере мужества и героизма севастопольской молодежи из книги Е.Д. Козицкой-Найденовой «Свет подземных школ» показано духовное единство народа и моральные ценности.

**Ключевые слова:** подземные школы, Великая отечественная война, осаждённый Севастополь, Инкерманские штольни, патриотизм.

**Annotation.** For the first time the feat of Sevastopol underground schools during the Second World war was described in the book written by Ekaterina Dmitrievna KozitskayaNaydenova the “Light of the Underground Schools” as an example of courage and heroism of the youth of Sevastopol.

**Keywords:** underground schools, Great Patriotic War, besieged Sevastopol, Inkerman tunnels, patriotism.

UDC94(4)"1939/45"

**NIKITA MIKHAILOVICH MAKAROV,  
MY GREAT-GRANDFATHER – DEFENDER OF MOTHERLAND  
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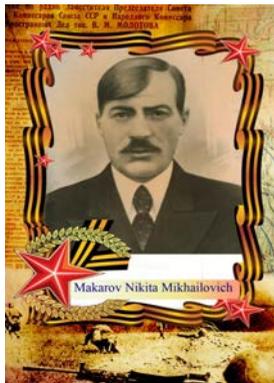
### **Introduction**

The Great Patriotic War was a difficult test for every person. All people living in the vast territory of the USSR were involved in the fight against a bloody war. Thanks to the joint effort of the rallied people, a victory was won in the war.

**The purpose** of this work is to describe the life of my great-grandfather **Makarov Nikita Mikhailovich** who participated in the Great Patriotic War of 1941-1945.

### **Defender of Motherland**

Red Army soldiers fought for their Motherland on the fronts of World War II. One of the fighters of the Red Army was my great-grandfather Makarov Nikita Mikhailovich, who made his heroic contribution to the Great Victory over the Nazis.



**Makarov Nikita Mikhailovich** was born in 1901 in the Mordovian Autonomous Soviet Socialist Republic, Purdoshkinsky district, the village of Purdoshki.

He was called to the Red Army at the beginning of the war, in 1941. Nikita Mikhailovich began his military service in the newly formed 326 rifle division. He served in the service and equipment division before

go to the front. On November 7, 1941, the division left Penza and became part of the 10th Army of the Western Front.

The 326 th Infantry Division, continuing its irrepressible attack, liberated the Baryatinsky station (now the village of Baryatino, Baryatinsky district, Kaluga region), thereby ensuring the liberation of the city of Sukhinichi by units of the 10th army.

After that, 326 th Infantry Division was heavy fighting for the aerodrome Shaykovka, but did not succeed. In these battles, only the 1099-th Infantry Regiment of the 326th Infantry Division lost 46 officers and 466 sergeants and privates.

In such heavy battles, my great-grandfather was killed on January 19, 1942 in the Smolensk region, the Baryatinsky district, the village of Novo-Shopotovo.

The loss of Nikita Mikhailovich dealt a serious blow to his family, which experienced great difficulties in the postwar period. My grandfather Makarov Vasily Nikitich, the son of Nikita Mikhvylovich, had to work and support his family from an early age.

I, Andrei Makarov, have not forgotten my great-grandfather-hero and will always remember him.

UDC 656.611

### **THE DEATH OF MOTOR VESSEL “ARMENIA”**

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**Introduction.** The periodical military-historical press has accumulated quite a few publications related to one of the most tragic pages at the Black Sea during the Great Patriotic War of 1941-1945 – the death of the sanitary vessel “Armenia”. In its scale, this marine disaster, which claimed the lives of more than 7,000 people, is not comparable even with the most famous tragedies that occurred with the Titanic and Louisiana, where there were several times fewer victims (combined) [1].

**Main part.** The Soviet hospital ship Armenia was a transport ship operated by the Soviet Union during World War II to carry both wounded soldiers and military cargo. It had originally been built as a passenger ship for operations on the Black Sea.

Armenia, built in 1928 at Baltic Shipyards in Leningrad (now St. Petersburg), was one of four Adzharia-class passenger liners specifically designed for use on the Black Sea. They were the first passenger ships to be built in the newly formed Soviet Union [2].

**The aim of scientific research** is to tell the story of the vessel "Armenia" and analyze the variants of the tragedy.

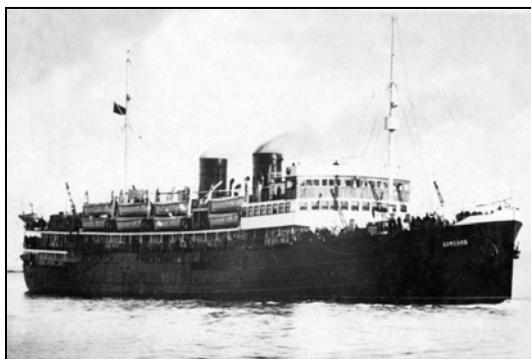
The tragedy happened on November 7, 1941. The day before, on November 6, the "Armenia" motor ship, taking on board the wounded and sick, as well as the personnel of the naval hospitals and representatives of the management of the Black Sea Fleet medical service, left Sevastopol with a call to the external raid of Balaklava in order to take out the employees of the People's Commissariat Internal Affairs (PCIA) and local hospitals. When vessel left Balaklava, the command of the sanitary transport vessel received an order to turn to Yalta and evacuate the hospitals located in Yalta, workers of Simferopol partially, and then directed to the Caucasus, the port of Tuapse. Both in Sevastopol and in Yalta, the loading of servicemen, wounded and sick, as well as evacuated citizens, was in a great hurry due to the difficult operational and tactical situation. Lists accepted for the ship were not compiled, and their exact number was not known. People begged to take them on a ship and filled all the office space up to the engine room. Departing from Yalta on the morning of November 7, the ship at 11 hours 45 minutes was torpedoed by the Heinkel 111 German torpedo bomber from the air and sunk within four minutes [1]. But many people don't believe in that version. At least one another version also exists. She was told by one of the survived people.

The RGS emphasizes that the hulk is unfragmented, sitting on an even keel heading 220. The hull is covered in ooze but has no obvious holes, which excludes the possibility of sinking by torpedoes, as the official version claimed. "At the same time, the superstructures and decks bear clear, ghastly traces of destruction: guard railings and other vertical elements are twisted outward. Most likely, these are the consequences of the explosions caused by aerial bombs. The main damage occurred in the middle and bow sections of the superstructure closer to the portside, which may indicate an aerial bomb attack along the course of the vessel, meaning German aircraft had attacked from the stern" –stated Executive Director of the Undersea Research Center at RGS Sergey Fokin, a member of the expedition [4].

According to another version, eight Nazi Junkers Ju 87 bombed "Armenia" at once. Of all those on board (recall, this is about 5-8 thousand people) only eight managed to survive. Anastasia Popova was among them. Despite of the terrible cold, she independently sailed to the shore. Anastasia recalled the terrible minutes of the tragedy like this:

«On November 6, 1941, on the advice of my friends, I decided to evacuate from Yalta. They took me aboard with great difficulty, as "Armenia" was already overwhelmed with wounded and refugees. When we have gone to the sea, the ship was attacked by enemy aircraft. Real hell has begun. Explosions of bombs, panic, screams of people – all mixed up in an indescribable nightmare. People rushed about the deck, not knowing where to hide from the fire. I jumped into the sea and sailed to the shore, losing consciousness. I didn't remember how I ended up on the shore» [3].

The shipwreck had been particularly actively sought over the last 20 years. Over that period, more than 300 sq. km of the sea bottom had been explored. The search was conducted by the Ministry of Defense of the Russian Federation. Specialists of the Undersea Research Center of the RGS took part in the survey and identification of the vessel [4].



Picture 1 – Motor vessel “Armenia”.

According to the report, the ship was discovered by the deep-sea apparatus of the Ministry of Defense off the coast of Crimea, about 18 kilometers from Yalta at a depth of 1500 meters. The preliminary location of the vessel was determined in 2016.

“Now doubts have been dispelled, and our point, announced back in 2016, was confirmed. Now we know exactly where the biggest disaster on the Black Sea lies. The ship was on a large slope, sliding into a crevice. Depth, as previously stated, 1500 meters” – said the representative of the expedition [5, www].

**Conclusion.** At the end of my report I would like to say due to the science, it became possible to find the vessel and thereby commemorate the victims, who were on it at the day of tragedy.

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**Аннотация.** Рассматривается история затопления теплохода "Армения", как одна из ужасных трагедий Второй мировой войны, унесшей жизни 6000-10000 человек. Благодаря науке спустя 79 лет теплоход был найден глубоководным комплексом по координатам, которые были определены учеными в 2016 году. "Армения" находится на глубине 1,5 тысячи метров, на большом склоне, примерно в 18 милях от берега.

**Ключевые слова:** Вторая мировая война, теплоход "Армения", 6000 – 10000 жертв, ужасы войны

**Annotation.** The history of the flooding of the ship "Armenia" is considered as one of the terrible tragedies of the Second World War, which took the lives of 6000-10000 people. Due to science, 79 years later, the ship was found by a deep-sea complex in the coordinates that were determined by scientists in 2016. "Armenia" is located at a depth of 1.5 thousand meters, on a large slope, about 18 miles from the coast.

**Key Words:** Second World War, motor vessel "Armenia", 6000 – 10000 victims, horrors of war

UDC 623.445.2

**THE HISTORIC ROLE OF PTRD – 41**

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**Introduction.** Prtd-41. Weapons that made a huge contribution in the early stages of the war. With an impossibly simple design, this anti-tank rifle was deadly to enemy armored vehicles. Which became a cult, this gun is still mentioned in various literary and film productions.

**Materials and methods.** I would like to start by saying about history of creation. When the Germans invaded, turns out they invaded with a lot number of light and medium tanks that were actually quite susceptible to an anti-tank rifle. Then the Soviet Artillery Directorate put out a request on anti-tank rifles. They were afraid that the infantry in combat would get separated from their anti-tank artillery support, and large crew that served 37, 45mm and larger anti-tank guns, would not be able to keep up with the infantry during combat. And they didn't want the infantry to be stranded, assaulted by tanks, and unable to defend themselves.

So, that was the idea behind having anti-tank rifles, and that's what set the parameters for the gun – has to be portable and operable by two men. These guns are actually remarkably effective on armor, more than pretty much any of the other anti-tank rifles that were being used at this time, including larger ones like the 20mm Lahtis and Solothurns. Very well designed armor-piercing projectile with a very high velocity cartridge made this gun as effective as it was. These rifles fired a 64 grams bullet at 1020 meters per second. And with that velocity and that bullet design this thing was able to perforate about 35 millimeters of vertical armor out in a distance to 275 meters – this is a lot more than you get with a British boys anti-tank rifle, or a Swiss Solothurn, or any of the German guns.

The Germans used an 8mm, a much smaller bullet, didn't have an armor piercing performance that these did. So up until about the middle of 1943, these guns were actually capable of defeating most of the German armored vehicles that were being encountered.

But, the most impressive element about this gun is just how quickly it went from concept, to production, to field use. In August of 1941, Stalin personally ordered the development of anti-tank rifles. Two different designers were both put to work on this, Degtyarev and Simonov. Degtyarev came up with this very simple a single-shot rifle. It was lighter, but has less firepower. Simonov came up with a gun that had more firepower, it could be disassembled, take the barrel off, so it was easier to

transport in the field, but it was also much more complicated to manufacture. Kovrov weapons factory was able to produce PTRD really quickly – almost everything on this gun can be made on a lathe, or is a very simple pressing, or milling operation. Later production had been also organized by the Izhevsk machine-building plant. And, by the end of August, they actually have these things in trials. Best source I found says the development timeframe on this gun was 22 days which is almost inconceivable.

**Results.** By November of 1941 these rifles were actually in the field and in substantial numbers being used. By the end of 1941 they had produced more than 17000 of these guns. By the end of 1942 that number had gone up to almost 185000. And by the end of 1943 the Soviet Army was fulfilled.

**Discussion and Conclusions.** Concluding what has been said above, I want to stress that these guns were a multi-purpose weapon. It stayed in service to the end of the war, so even after the Germans were used tanks that weren't really all that vulnerable to these guns – Panthers and Tigers – they were still deployed and used extensively for shooting at other things – light armored vehicles, trucks, emplacements, that sort of thing. Thus, we see that PTRD is rightfully considered as a weapon of victory.

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**Аннотация.** В данной работе описывается, что во время ВОВ разные виды оружия использовались, самые эффективные описаны в статье. Для разработки лучшего оружия для победы двое инженеров были привлечены к разработке – Дегтярев и Симонов. В конечном итоге, противотанковое ружье системы Дегтярева было признано оружием победы.

**Ключевые слова.** Оружие, пистолеты, ружья, разработки, сражение.

**Annotation.** Different kinds of weapons were used during the World War II. The most effective weapons are described in this paper. Degtyarev and Simonov were both put to work on the realization of the best weapon. Finally, the PTRD is rightfully considered as a weapon of victory

**Key words.** Weapon, guns, rifles, development, combat.

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**MY FAMILY IN THE HISTORY OF THE FATHERLAND**

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*In memory of my great-grandfathers I.A. Mikhaylov and A.T. Shapovalov*



Steba Vika in the garrison cap of great-grandfather Ivan

History has been created for many centuries. Every moment of this life is possible only because there were centuries before it. We must remember this, be clearly aware of it, in order to continue to live, to remain a full-fledged person – a link in the flow of future time [4]. The memory of our ancestors is one of the main wealth of our soul. After all, in order to live now many generations of people made life as we saw it.

The memory of departed relatives is sacred. "Under every tombstone – there is a world's history" – said G. Heine. And indeed, each person is unique in their individuality, each leaves his/her own mark in life, the memory of their deeds, thoughts, and life aspirations. We don't remember our great-grandparents, but the remaining photos take us back to the past. My great-great-grandfather Mikhaylov Anisiy Pavlovich was a soldier of the Russian army in 1914-1918.

On the back of the photo the text is written:  
"For all relatives, sons, grandchildren and  
great-grandchildren for eternal memory.  
Remember and do not forget your honest family".

How can you forget that?!!



Photo 1 – Mikhaylov Anisiy Pavlovich

In the fate of each person, the main events of life are predetermined, such as the creation of a family, the birth of children, severe diseases,

income level, time of death, and others. Fate is the fulfillment of our desires and their consequences. It doesn't always happen that we want. Two of our great-grandfathers were in the camps against their will. Dachau and Buchenwald were the worst of the camps, worse than death. People were experimented on, but they hoped to win and survived.

In the fate of each person, the main events of life are predetermined, such as the creation of a family, the birth of children, severe diseases, income level, time of death, and others. Fate is the fulfillment of our desires and their consequences. It just doesn't always happen the way we want it [5].



Photo 2 – Alexey and Claudia Shapovalovs    Photo 3 – Ivana and Matrena Mikhailovs

Graduates of the 10th class of 1941 also dreamed about a beautiful fate, family, happy future...

The power of our thoughts and desires is wide. In other words, every action of a person leaves one or another imprint on his/her fate. What young people dreamed about on the morning of June 22, 1941, when they met the morning dawn; they did not think about the war – a terrible, destructive, destructive force that interrupted not only the thoughts of a happy life, but also crippled human lives. Already on the next day after graduation, they thought about the Victory over the enemy and the fascist, who treacherously destroyed all good thoughts, destinies...

My great-grandfather Ivan Anisimovich Mikhaylov was born in Novgorodka, Kirovograd region, on September 8, 1923. When the Great Patriotic War began, Ivan Anisimovich was 17 years old. On June 22, 1941, he had a graduation party. All plans for the future, all hopes and dreams remained there, in June of forty-first year... Great-grandfather Alexey Timofeyevich Shapovalov was born in Ingulo-Kamyanka village, Novgorodkovsky district on February 6, 1914. During the German occupation of 1941-1944, Ivan Anisimovich and Alexey Timofeyevich were in their villages. In the first days of the occupation, the Nazis shot more than 10,000 civilians in Kirovograd and 52,000 from the Kirovograd region. The Nazis carried out mass arrests of Communists, Komsomol members, Soviet activists and their family members, subjected them to severe torture, and then shot them without trial.

"Sometimes people were caught on the streets, in markets, in other public places. But more often, special quotas for the export of people to Germany were issued to cities and villages, on the basis of which local collaborationist authorities compiled lists and sent out summonses. And here, of course, whole tragedies unfolded, human destinies were broken. For example, it was in villages and small towns where everyone knew each other" [7, www]. Sometimes they were taken out by whole families with newborn children. In most cases, Komsomol members, older children from large families, and poor people who could not pay off were taken first.

My great-grandfathers I.A. Mikhaylov and A.T. Shapovalov were among those prisoners taken to Germany. Grandfather Alexey was driven to Germany at the end of 1943 to camp № 5, Munich, and grandfather Ivan in January 1944 to Poland, Przemysl, then Germany-Gros-Rosen (stone quarry camp, № 46942), then Aschersleben (broken Anglo-American aircraft factory), then Dachau camp.

The Dachau specialized camp, the first concentration camp in Nazi Germany, began operating on March 22, 1933. This was the first experimental training ground where the system of punishments and other forms of physical and psychological abuse of prisoners was practiced. Before the Second World war, political opponents of the Nazi regime – primarily Communists, socialists, and clergymen-were held in Dachau (photo 4). In Dachau, my grandfather could meet each other. Fate brought them together after the war. Alexey Shapovalov in the future gave his daughter in marriage to the son of Ivan Mikhaylov – Grigoriy.

After Dahao, they were chased to Buchenwald. Nazis chased them like animals, but they didn't count them as people. There was also Gros-Rosen (stone quarry camp, No. 46942), then Aschersleben (broken up by the Anglo-Americans aircraft factory).



Photo 4 – Documents confirming your presence in the camp

The allies liberated them in Wittenberge and were transferred to the Red Army. After liberation in April 1945, they were in the Western part of

Germany, where the main industry of the Third Reich was concentrated, so they were released by the British and Americans.

After the release, Ivan Anisimovich took the oath and fought in the anti-aircraft company of the 1031st rifle regiment as a machine gunner, whose commander was V. Grishin. Mikhaylov Ivan was dispatched to the 6th front-line brigade as a gunner in June, 1945. He was demobilized to pursuant Decree of the Presidium of the Supreme Soviet dated 4.02.1947.

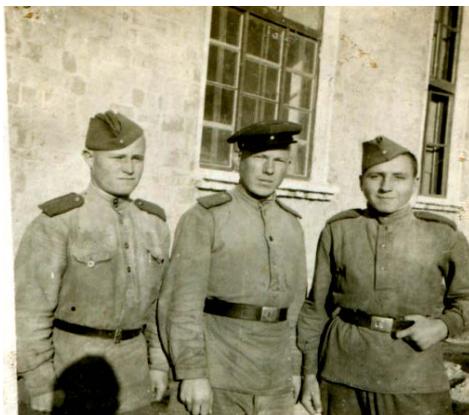


Photo 5 – I.A. Mikhailov (left) with soldiers (Livitie, Kurilov) of anti-aircraft company of the 1031st rifle regiment

Great-grandfathers were awarded by many medals, the order, the medal "Veteran of labor". Both grandfathers were prisoners of Dachau and both worked as signalmen, laying cables for hundreds of kilometers.

A lot of work has been done to find evidence of the grandfathers' captivity. Search results in the state archives of the region, then in the national Committee of the Red Cross Association did not give anything. Grandfathers talked in detail about their confinement in the camps, so the search became more extensive.

In our memory, great-grandfathers and grandfathers will forever remain heroes of war, heroes of labor, the best grandfathers in the world.

Summary.

The fate of a person is in his/her hands, if another person does not destroy it, does not change it. We hope for a happy future without war. We will do everything to build a beautiful future in memory of the war heroes who gave their lives for ours.

Every year there are fewer and fewer witnesses of those terrible war years, so today it is so important to collect and preserve every memory. Grandfathers told their war history to their grandchildren so that we, great-grandchildren, would know, remember, and be proud of the dead and the

living who won this war. We, in turn, will pass the archive data to the next generation.

It was past generations that created us today, and raised our thoughts and feelings to the heights of human wisdom. After all, man exists in the world not only as a thinking and feeling being, but also as one of the links in a strong eternal chain connecting the past and the future. The more a person values the memory of their fathers, grandfathers, and great-grandfathers, the more aware they are of their place in this world, and the more deeply they feel their responsibility for the future.

In our memory, great-grandfathers and grandfathers will forever remain heroes of war, heroes of labor, the best grandfathers in the world

We remember! We are proud!

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**Аннотация.** Рассказано о героической судьбе прадедов, их судьбе. Оба деда оказались в одном лагере – самом страшном лагере Дахау, о чем свидетельствуют документы, взятые из семейного архива.

**Ключевые слова:** Великая отечественная война, узник, лагерь Дахау, Бухенвальд.

**Annotation.** The fates of the grandfathers Mikhailov I.A., and Shapovalov A.T. are described. By the will of fate, both of author' great-grandfathers were in the same camp – the most terrible camp of Dachau. The documents with the personal number of the prisoner in Dachau are presented.

**Keywords:** Great Patriotic War, prisoner, Dachau camp, Buchenwald.

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### **KEEPING MEMORY IN THE HEART**

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*Older men declare war. But it is the youth that must fight and die.*

**Herbert Hoover**

#### **Introduction**

It is well known, that any war are inhuman. Millions of people were killed during the war. In 1941, Germany, having powerful weapons, attacked our country and unleashed a war. The Great Patriotic War of 1941-1945 brought countless suffering, grief and tears to all the peoples of the Soviet Union. War brought sorrow to every home. Fathers, children, husbands, brothers and sisters from each family went to the front. Thousands of citizens of the Soviet Union experienced terrible difficulties. However, they survived and won thanks to incredible efforts, dedication and sacrifice.

**The purpose** of this work is to describe the life of my fellow villager **Nikolai Mikhailovich Sosedov** who participated in the Great Patriotic War of 1941-1945.

#### **Defender of the Motherland**

**Nikolai Mikhailovich Sosedov** was born on December 19, 1923 in the village of Manzy near Krasnoyarsk.



In May 1942, Nikolai Mikhailovich Sosedov was called up for military service into the Red Army. He was trained in the infantry troops and was sent to defense Stalingrad.

The battle of Stalingrad was the most bloody in modern history. In total, more than 1,530,000 people were killed, wounded or captured. In Stalingrad Nikolai Mikhailovich was wounded in the leg. After treatment he returned to his military unit and went into battle again. In Stalingrad Nikolai Mikhailovich saw how Paulus was captured.

The 62-nd Army in which Nikolai Mikhailovich fought was awarded the title of the 8th Guard for the heroism of soldiers and officers in the battles for Stalingrad.

After participating in the battle of Stalingrad, Nikolai Mikhailovich was a soldier of The 3rd Belorussian Front.

The battle of the Dnieper was one of the largest Second World War operations, involving almost 4,000,000 troops on both sides and stretching on a 1400 kilometers long front. During this four-month operation, the eastern bank of the Dnieper was recovered from German forces by five of the Red Army's Fronts, which conducted several river assault crossings to establish several bridgeheads on the western bank. Subsequently, Kiev was liberated in a separate offensive [1].

Participation in the battle of the Dnepr is the most severe memory Nikolai Mikhailovich. The Dnieper battle involved 4,000,000 personnel of Red Army. According to the memoirs of Nikolai Mikhailovich, the losses were so great that the bodies of the dead soldiers were used as barricades.

Than in Belarus, he was seriously wounded and freeze on the marsh. Nikolai Mikhailovich lost a lot of blood but was found and saved by a comrade.

After the liberation of Poland, Nikolai Mikhailovich fought in Germany. In the German city of Branderburghe learned that the war was over. This happened after May 5, 1945. When the war ended he served in Brandenburg with the Allies until 1947.

**Nikolai Mikhailovich Sosedov** is a participant in the **Victory Parade of 1945** in Moscow. He marched in the sixth row.

For military merits, the front-line soldier **Nikolai Mikhailovich Sosedov** was awarded the **Order of Lenin**, the **Order of Glory** of the II degree, the **Order of Glory** of the III degree, the **Order of the Patriotic War II degree**, the **Order of the Red Star** and medals.



The memory about **Nikolai Mikhailovich Sosedov** we will keep and pass from generation to generation. Nikolai Sosedov's life will be the perfect example for all of us.

## **We are proud of our great countryman!**

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### **WAR IN LIFE OF THE VOLGA REGION GERMANS TSOL CARL AND TSOL DOROTHY**

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The Great Patriotic War is the most terrible war in the history of our country. Thousands of brave soldiers died in the battles for the homeland, leaving their children orphans and their wives widows. It is difficult to find a family in our country that did not lose anyone in this terrible war. This war was not spared my family.

My great-grandparents **Tsol Karl and Dorothea** were Russian Germans and lived in a settlement in the Volga region. Their life flowed calmly and orderly in a settlement among orchards and flowers.



In summer of 1941, life changed. On June 22, 1941, Russian Germans, like the entire population of the Soviet Union, learned about the German attack on the USSR and the beginning of the Great Patriotic War.

In late August, 1941, Germans from the Volga, Saratov and Stalingrad regions were deported by Stalin's Soviet government to Siberia, Kazakhstan, and other remote regions because of their German heritage.

The formal decree came on 28 August 1941 which abolished the Autonomous Socialistic Soviet Republic of the Volga Germans. The Volga Germans were now treated as prisoners and were transported by rail to the camps.

The deportees were transported, usually in railroad cattle cars and only given water when the train stopped every three or four days. The food, as a rule, was salted herring, which only increased the thirst of prisoners.

Thousands died during journeys which lasted up to two months. In some cases, bodies were left in the overcrowded cattle wagons for weeks. In others, they were thrown out beside the tracks. Upon arrival in Siberia, many of the deportees were forced to work in the Trudarmy (labor army) in the camps. The Volga Germans were then stripped of their citizenship and did not regain their civil rights until after Stalin's death.

At the end of September 1941, my great-grandmother and great-grandfather with three children were sent to Siberia. They were not told where they would be deported. On gathering the necessary things they did not have time. Hence, they set off scantily dressed and with just little luggage.

My great-grandfather and great-grandmother with other Russian Germans traveled to the place of their future residence for 7 weeks, first by barge and then by train. They traveled in the most difficult conditions: cramped conditions, cold, lack of hot food.

Before being deported to Siberia, Karl and Dorothea had 8 children. On the way, in unbearable conditions, 6 children died. Only baby Maria and 4-year-old Karl were able to stay alive. Karl and Dorothea arrived in a taiga village in the Krasnoyarsk Territory, Idrinsky District. They found themselves with inadequate clothing, no shelter, and no means to support themselves in temperatures as low as -40°C in Siberia.

During the war, my great-grandfather was sent to a special labor camp, where he stayed for more than 4 years. He worked 12-14 hours a day. The conditions were very severe, food was simply not enough at all. Everyone who worked there lived in barracks.

Great-grandmother Dorothea remained in the settlement because she had a baby. She worked on the collective farm from morning until evening. In addition, she had to have her own household in order to have food.

After the Victory of the Soviet Union over fascist Germany, the Trudarmy (labor army) continued to exist. In 1946, like many other workers, great-grandfather was able to return to his family. Those who worked in the Trudarmy were sent home by train. Great-grandfather was so exhausted that he was sent in a carriage where there were dead people. When he returned alive, great-grandmother nursed him for a year.

However, they could not return home to the Volga region; they did not have documents until 1956. And it so happened that my great-grandfather, Tsol Karl and Dorothea, remained in Siberia forever.

After Karl returned from the Trudarmarmy, the Tsol family moved to live in the village of Nikolaevka. Karl and Dorothea did not live together for long. Karl died in 1954 at the age of 42. When Karl died, his family experienced great financial difficulties. Instead of studying, 17-year-old Karl and 13-year-old Mary had to work on a collective farm with their mother in order to feed their family. Dorothea did not get married. She died in 1998 at the age of 85.

Karl and Dorothea gave birth to 3 more children in Siberia. In 1948, Raisa was born, my grandmother. Then in 1951 Lydia was born, in 1953 Emilia was born. Karl and Maria received only a 4-year education. Raisa, Lydia and Emilia had more opportunities to get an education. They received secondary education and continued their education in colleges. Raisa became a teacher and worked as a teacher of German in school. In 2003, she and her husband went to live in Germany.

Lydia worked for many years at a poultry farm in Krasnoyarsk. In the early 2000s, she also left for Germany with her family. Emilia worked at a gas station for most of her life. She is now retired, lives in the village of Krasnoturansk. Maria worked on a collective farm. She is currently retired, lives in Nikolaevka. Karl, like Maria, worked on a collective farm. He retired and moved to live with his children in Omsk. Unfortunately, he died two years ago.

I, **Werner Natalia**, a descendant of **Tsol Karl and Dorothea**, will always remember everything that they experienced during the Great Patriotic War. That war destroyed the happy life of my ancestors, that war brought misery and difficulties in my family. Nevertheless, my great-grandfather and great-grandmother made their labor contribution in the name of the Great Victory.

## SECTION 4: HISTORY AND THEOLOGY



UDC 930.85/910

### **THE HISTORICAL SIGNIFICANCE OF THE YALTA CONFERENCE IN THE POST-WAR WORLD ORDER**

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**Introduction.** 75 years have passed since the end of World War II. World War II was the worst disaster in the history of mankind. Its results gave a vector of development of society for decades. The history of the Second World War and the Great Patriotic War may never lose its relevance. "Even children showed courage and heroism. Despite the bombing they continued to study" [5, p.287]. The discovery of new documents, facts, changes of values in modern society is changing people's attitudes to the history of the war, from which we should learn - this is an important feature of the thinking man. Moreover, it gave a lot of negative examples, including the development of the world in the 20th century. The past century was a period of global clashes and confrontations, world wars, in which a significant number of countries from several continents were involved. But the experience of the last century taught mankind little. The desire for dominance is still inherent in some countries. The world continues to arm itself, showing its inability to abandon war as a tool for resolving contradictions. Therefore, the problem of studying and updating knowledge on the history of wars and armed conflicts is of greatest importance today.

**The main part.** Famed military leader and a gifted strategist Erich von Ludendorff after the Battle of Amiens noted that "August 8, 1918 represents the black day of the German army in the history of World War II." It is obvious that the German General foresight is clearly lacking, he could not conceive that the day is much more black, come to the German Army a little more than a quarter of a century later. Allied landing in Normandy and opening a second front in Western Europe have deprived the German army

last embers of hope, a more or less acceptable end of the war left after 1943 [1-4].

The most significant political event of the beginning of 1945 a meeting of the leaders of the three great powers of the anti-Hitler coalition - the USSR, the USA and the UK, which took place from 4 to 11 February in Yalta, in the Lydian palace, in the newly liberated post-war Crimea. Until now, the results of the Yalta Conference are known as the Yalta World. I would like to note that despite the fact that the United States, Great Britain and the Soviet Union opposed Germany on the sidelines of World War II, they found it very difficult to find any common ground, but still the "Yalta World" got its foundation in Crimea.

Yalta Conference was the second meeting of the leaders of the three great powers of the anti-Hitler coalition - the USSR, the United States and England, and she, like Tehran, was marked by the prevalence of the trend towards the development of agreed decisions in the organization of the final victory, and in the postwar. In February 1945, there was no doubt that the collapse of Hitler's Nazism inevitable. The victory was only a matter of time over Germany. Therefore, the heads of the three great powers were well aware that there was an opportunity to change the entire political map of Europe, especially in its central-eastern part. The fate of Europe was depended on the leaders of all three countries [9-11].

At the International Conference in Yalta, the fate of Germany was discussed. The allies agreed that Germany would be occupied and that special authorities would be created on its territory, which would then be led by the military of the three countries. Indeed, this body was created, but after the advent of nuclear weapons, almost all the agreements reached regarding Germany were violated. It was also agreed that all countries will have allies' occupation zone of Germany, therefore, Germany was divided into East and West. And we know that in Berlin was allocated these two zones. Germany had to be disarmed, abolished the military and economic potential, as in Yalta and raised the question of reparations, because the territory of the Soviet Union was destroyed, but the exact solution about the payments were not made in cash.

One of the most difficult and most controversial was the question of Poland. Allies define the boundaries of the Polish state, which were installed on the "Curzon Line" with minor changes in favor of Poland itself. It received the territorial gains in the west and north.

It should be mentioned that the implementation of the idea of creating a new League of Nations in Yalta, the future United Nations, was launched. It was decided to establish in the near future together with Allies of a general international organization to maintain peace and security. It was essential, both to prevent aggression and to remove the political, economic and social

causes of war through the close and continuing collaboration of all peace-loving nations.

Since the leaders of the three great powers of the anti-Hitler coalition was required inter-governmental organization, which would be able to prevent the attempts to change the decisions of the Yalta Conference and established spheres of influence. It was in Yalta that the ideology of the United Nations was formed.

It should be noted that most of the articles of the UN Charter was adopted at the conference at Dumbarton Oaks, a suburb of Washington in 1944, which was convened at the initiative of the Soviet Union [7, 8].

The UN Charter is the main document of contemporary international law. It could not be of any importance without the key provisions of the roles and relationships of the great powers in the Security Council. This issue was resolved at the Yalta Conference. At the meeting, the leaders of the three great powers of the anti-Hitler coalition in Yalta were taken the most important general declarations. Such is the "Declaration on Liberated Europe", which provided for the harmonization of the policies of the three powers and their joint actions in resolving the economic problems of Europe in accordance with democratic principles. These principles affected the very essence of political systems; therefore, they could be interpreted in different ways. However, they expressed precisely those general political features and social ideals, under the banner of which various forces fought against fascism in Europe and around the world [6].

The communiqué of the conference of the leaders of the three allied powers - the USSR, the USA and the UK there is, in my opinion, one of the most important chapters. The unity in the organization of the world, as well as in the conduct of war, it is said that only with continued cooperation and understanding between all three countries and all peace-loving peoples can be implemented in a durable and lasting peace.

**Conclusion.** It can be concluded that it is the Yalta Conference which determined the further order of the world order. That geopolitical era, set in Yalta in February 1945, had a number of historically important meanings. Firstly, it was eliminated multi-polar system of international relations, has come to be replaced by a bipolar, in which the leading role was played by the two countries. Consequently, the post-war world has ceased to be Eurocentric, and has become a global one. Secondly, at the Yalta Conference, the possibility of cooperation between the three great powers of the anti-Hitler coalition, which in turn had a different social system, was shown. "Yalta world" was destroyed at the turn of 1980-1990s, and subsequently definitively ceased to exist. Some of the mechanisms of the Yalta-Potsdam system function this day. However, the destruction of the Yalta World, the desire to establish a unipolar world order led to a new geopolitical crisis, a strong increase in terrorist threats and the danger of a clash of civilizations.

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**Аннотация.** Геополитическая эпоха, заданная в Ялте в феврале 1945 года, имела ряд исторически важных значений. Обсуждались вопросы о продолжающем сотрудничестве и взаимопонимании между всеми тремя странами и всеми миролюбивыми народами, о прочном и длительном мире. Сделан вывод о том, что именно ялтинская конференция предопределила дальнейший порядок мироустройства, который смог просуществовать до распада СССР.

**Ключевые слова:** Вторая Мировая Война, Великая Отечественная война, лидеры трех великих держав антигитлеровской коалиции-СССР, США и Великобритании, «Ялтинский мир», ООН, Ялтинская Потсдамская система.

**Annotation.** The geopolitical epoch in Yalta in February 1945 had a number of historically important meanings. The issues of continued cooperation and mutual understanding between all three countries and all peace-loving peoples, as well as a lasting and lasting peace were discussed there. It was concluded that it was the Yalta conference that predetermined the future order of the world order, which was able to exist until the collapse of the USSR.

**Key words:** Second World War and the Great Patriotic War, leaders of the three great powers of the anti-Hitler coalition - the USSR, the USA and Great Britain, «Yalta world», United Nations, Yalta-Potsdam system.

UDC 28/26

## **CHRISTIANITY AS A STATE-FORMING FACTOR OF UNITING RUS'**

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**Introduction.** The most important area of research activity of the theologian is the study and description of the role of theology in the history of state-confessional relations – from the initial period of the formation of the Russian state to the present. The process of Christianization of Russia for research in this context is of particular importance.

The distribution of Christianity in Russia had its own specifics: it came to our state as a spiritual revolution, and the process of

Christianization of Russian society took place not from the bottom up, according to the Roman model, but from the top down - from the Prince, from the social top of society to the people. This specificity has caused the existence of a rich pre-Christian tradition in Russian society.

**Main part.** Russia was surrounded by states and peoples who had different faiths and through mutual contacts exerted influence on it related to trade, farming, culture, interested in expanding their influence on Russia through faith: Byzantium, Rome, Khazaria, Volga Bulgaria.

The news of the desire of the Kievan Prince Vladimir to introduce a new religion instead of paganism was accompanied by the sending of spiritual missions to Kiev from Mohammedans, Jews and Latins.

In the "Tale of temporary years" a significant place is given to the critical attitude to various faiths, including the mission of 986 to Kiev from Volga Bulgaria, whose representatives convinced the Prince of the expediency of accepting Islam as the state religion of Russia.

An influential reference point for the election of faith was Christianity, which for almost a Millennium penetrated the East Slavic lands from the South and West. The deterioration of relations between Rome and Byzantium in the IX-X centuries without objective reasons led to the distancing of the Western and Eastern Christian churches, who tried to attract Russia. Princess Olga, having accepted Christianity in Constantinople in order to achieve compliance from Byzantium for Russia, resorted to pressure on Constantinople, inviting German bishops to Kiev, and her grandson Prince Yaropolk-Vladimir's predecessor in possession of the Kievan throne was secretly baptized in the Roman rite and established close ties with the countries of Western Europe.

However, according to the chronicle, the Church service that was crucial in choosing Christianity of the Byzantine rite was the one that the Russian ambassadors got acquainted with when they specially came to the capital of the Empire: the Byzantine Tsar, together with Patriarch Nicholas, gave great honor to the ambassadors [1].

Having an effective means of influencing Byzantium-military force – after long comparisons in choosing the ways of further development of the state, the Prince chose the Eastern vector of the baptism of Russia, which was due not so much to cultural as to geopolitical factors. Kiev-an important point on the way from the "Varangians to the Greeks" became the center of Russia and fell into the orbit of Byzantine political and economic interests. Byzantium took the first place among the partners of Russia.

The phenomenon of the Orthodox faith in the power of its impact on a person, first of all, revealed a true miracle in the transformation of the ruler's personality, who chose the Orthodox faith as the basis of statehood.

However, we know from the Holy Scriptures that Christ values the internal feat of people above all who managed to completely change their

minds and lives, to rise spiritually from a deep abyss. The Prince, in fact, changed in Christ, accepted Christ, rejected all his pagan sinfulness and began to live in a new way and teach other people, became a Grand Prince, and his state was one of the largest in Europe. The God was preparing a great bright road for him. "Where sin has multiplied, there," according to the Apostle, "grace has begun to flourish" (Rom. 5: 20). And "a merciful eye of the Seelie God looked at him looked at him, and came upon him the grace of the most high, and conceived the idea of heart when he realized all the vanity of the idols of temptation, and started to search for the one God, creating all things visible and invisible" (from Saint Vladimir the Great). Vladimir decided to accept the new faith, not only to join the culture of the advanced States of that time, but also to unite them into one nation - the Russian one.

The chronicle tells about the events of 988, that after a six-month siege of Chersonesus and the capture of the city, Vladimir sent messengers to Tsar Basil and Constantine, who did not fulfill the agreement on military assistance against Varda Phokas, and ordered to convey: "I took your glorious city, but when you do not give me my sister Anna, then I will do the same with your city of Tsargrad as with Chersonesus." The tsars in response promised to persuade Anna, and Vladimir translated: "baptize, then we will send my sister to you."

Vladimir answered: "Yes I will call those (priests) who will arrive along with your sister". The tsars agreed and sent sister Anna to Vladimir, and Metropolitan Michael to the Russian see with his retinue, clergy, many Holy relics and other shrines.

This chronicle ends with an interesting remark about the baptism of Prince Vladimir: "Without knowing about it, (some) falsely say that Vladimir was baptized in Kiev, others say that in Vasily (Vasilkov), and other people tell another story" [3, p. 387]. In ancient Chersonesos, where every stone remembered St. Andrew, the wedding of St. Vladimir and blessed Anna took place.

So, the Prince returned from the campaign to Korsun a glorious winner at the head of a loyal team, with his wife, a Greek Princess, the brother-in-law of the then powerful Greek Emperor in the world. Vladimir's authority has increased significantly. That is why he dared to destroy the old faith and violate the people's sanctity [3].

After becoming a Christian, Vladimir the Great completely changed his life: Vladimir treated the sick and poor mercifully, organized a secular and a number of spiritual schools, and began to build a magnificent Church in honor of the Dormition Of the mother of God, which was called the tithe Church, since the Prince assigned a tenth of his income to its construction, and imirians followed his example. Built on the site of the pagan statue of Perun, it became a symbol of the victory of Christianity over paganism. The

Prince successfully chose one of the creeds about the one God, each of which had a significant part of its supporters in the lands of Russia – Greek or Latin Christianity, Islam or Judaism as the state ideology and creed, and remained in historical memory as a Grand Prince-statesman.

**Conclusion.** The Christianization of Russia was prepared by the entire course of history and the objective needs of the time. The adoption of Christianity as the state religion in 988 was an inevitable natural step for the development of society at that time, which determined the further that for centuries, and the Tauride Chersonesus was destined to become the source of the Christianization of Russia. The significance of the great ruler of the Russian state's choice of faith, which became a powerful unifying force and led to the creation of a stable state, can hardly be overestimated.

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**Аннотация.** Рассматривается роль христианства как важнейшего государство-образующего фактора, обеспечившего консолидацию Руси.

**Ключевые слова:** конфессиональные отношения, христианизация Руси, «Повесть временных лет».

**Annotation.** The article considers the role of Christianity as the most important state-forming factor providing the consolidation of Russia.

**Keywords:** confessional relations, Christianization of Russia, "Tale of bygone years".

UDC 93/94

**THE HERO CITY OF NOVOROSIYSK**

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### **Introduction**

On May 9 Russia celebrated Victory Day in the Great Patriotic War of 1941-1945. The Soviet people fought for freedom and independence of their country against Nazi Germany and its allies.

Hero City is the highest degree of distinction awarded to the twelve cities of the Soviet Union. These cities were famous for their heroic defense during the Great Patriotic War of 1941-1945.

### **Materials**

On August 17, 1942, the Novorossiysk defensive area was created in Novorossiysk. It included the 47th Army of the Soviet Union's Red Army and the Black Sea Fleet. A militia began to form in the city. Before the offensive of the fascist army, 200 defensive structures were built in the city. 30-kilometer anti-tank barriers were erected in front of the city.

The fascist army planned to capture Novorossiysk. Having captured the city, the Nazis gained access to the Black Sea coast and continued the attack on the Stavropol Territory.

In early September 1942, the destroyer squadron "Soobrazitelnyy" and the main destroyer "Kharkiv" launched powerful artillery strikes on clusters of fascist army. On September 7, 1942, the enemy managed to enter the city and capture several administrative objects in it. But four days later the fascists were stopped.

The victory in this battle was brought by the Black Sea Fleet. On the night of February 4, 1943, naval forces landed from ships and liberated Novorossiysk.

### **Results**

The memory of the events of the Great Patriotic War that occurred in Novorossiysk will live forever. After all, the feat of our grandfathers must always be in our hearts.

**Аннотация.** Цель данной работы: рассмотреть подвиг города-героя Новороссийска в годы Великой Отечественной войны 1941-1945 годов.

**Ключевые слова:** город-герой, Черное море, Великая Отечественная Война, Советская Армия. Победа.

**Annotation.** The purpose of this work: to consider the feat of the hero city of Novorossiysk during the Great Patriotic War of 1941-1945.

**Keywords:** Hero City, the Black Sea, Great Patriotic War, Soviet Army. Victory.

**REVIVAL OF RUSSIAN ORTHODOX FAMILY VALUES AS A  
WAY TO OVERCOME SPIRITUAL CRISIS IN  
CONTEMPORARY RUSSIA**

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**Introduction.** The problem of spiritual and moral education of the younger generation during two decades has maintained priority positions both in the rating of scientific discussions and public discussions at different levels. Crisis phenomena overcoming, searching for alternatives to lack of spirituality, the destructive influence of mass media on the younger generation, and ways to acquire stable moral principles are the main imperative in the struggle for the spiritual and moral well-being of young people.

**Main part.** The aim of our article is to highlight the possibilities of solving problems in the spiritual education of children by reviving the traditions of Orthodox family pedagogy, Orthodox traditions of educating spiritual and moral qualities based on the highest standards of the Orthodox faith, which forms the needs for spiritual interaction and enrichment of spiritual experience. “In order to stop the ongoing decline in cultural and intellectual level of the nation, the revival of traditional spiritual and moral values is required” [3, p. 21]

Spiritual values as ideals established by society are intended to determine the successful socialization of a young person, his/her aspirations, formation of worldview, individual one on the surrounding reality [5].

Problems of spiritual and moral education are enshrined in the Laws of the Russian Federation “About education” and “About the basic guarantees of child rights in the Russian Federation”, in the Concept of education modernization.

It is important to note that our country lives in a situation not only diversity of values, but also their collision, in the conditions of re-evaluation values, when the domination of material values becomes more obvious.

It should be noted that the value has a spiritual nature and can be presented as an essential characteristic of society's consciousness.

Value is always objectively subjective, diverse, and historically determined. Spiritual culture of different times contributes to the change of values: some dominate, others become less important.

Having lost universal stability, culture today not only loses its value sense, it turns into a profitable entertainment, a spectacle devoid of spiritual meaning. "All this is evidence of the crisis tendencies of culture" [2, p. 18].

"Misunderstanding or misinterpretation of spiritual values and ideals creates favorable conditions for social egoism increase, moral chaos, universal bitterness, leads to an increase in crime, spiritual impoverishment" [5, p.60].

Many scientists, outstanding figures of culture, science, and art speak about this today. R.G. Abdulatipov, I. Kant, G. Hegel, A. Schopenhauer, F. Nietzsche, J.-P.Sarra, G. Spencer, P. Ya. Chaadaev, V.S. Solovyov, F.M. Dostoevsky and many others, analyzed the state of spiritual culture and information promoted by the media.

They noted that today "humanity has crossed the threshold beyond which the degradation of the individual begins" [1, p. 3]. Modern reality presents lessons of total deception and fraud in the sphere of spiritual culture, which in their unity represent a purposeful work to destroy the national identity of the Russian people, deprive them of their historical memory, blurring the boundaries between the spiritual and the spiritless, between good and evil.

Internet complements the picture of spiritual destruction of the erasing international borders, creating only the appearance of entering the world culture, it attracts with original ads, colorful images, crazy games that narcotic attract and decompose the person not only spiritually, but also physically.

At the same time, the crisis situation in Russia is supplemented by the consequences global disasters, wars, fires, natural disasters, religious differences, national hatred, international terrorism, aggression, distorted ideas of basic decency. All this has a powerful negative impact on the true universal values and ideals, transforming their content, thus causes irreparable harm to the individual and society as a whole.

There is a misrepresentation in emphasis in the development of children towards early intellectualization, which does not contribute to spiritual development.

Properly organized education and the process of learning the child's experience of social life, formed a condition for active preschool child's knowledge of the surrounding social reality is crucial in the formation of personality [5].

"From the first years of a child's life, familiarizing with culture and universal values helps to form the foundation of morality, patriotism, the basis of self-consciousness and individuality" [4, p. 8]

The main areas of a child's life, in which there is a continuous process of spiritual and moral development of personality, are family, Church, and school. The family forms the foundations of a spiritual and moral upbringing of the child, but one must be a member of the Church for his/her spiritual formation and growth and the difficult task of churching the family provides great assistance to the parish Sunday school.

Sunday school helps the child to understand such important ontological concepts as God, the universe, life; it introduces the science of oneself, giving him/her a true idea of the meaning and purpose of life, and prepares to the mysterious life of prayer and to understanding of his/her own spiritual experience – the experience of communion with God. Various forms of lessons, common temple prayer, active participation in worship and any common work for the benefit of the Church, joint tea parties, pilgrimage trips, participation in various events, competitions and events organized by the Sunday school department, unite children and promote the communication. Bishop Theophan writes: “The spirit of faith and piety of parents should be considered the most powerful means to preserve, educate and strengthen the life of grace in children”. First of all, he reminds about a goal of upbringing [5].

The need of revival of spirituality of the Russian people indicated in the “Concept “About spiritually-moral development and education of the person citizen of Russia”, the state program “Patriotic education of citizens of the Russian Federation for 2016 – 2020”, in the speeches of the President of the Russian Federation V.V. Putin (speech at a meeting with representatives of Russian youth on Patriotic education of the younger generation), the Minister of education O. Vasilieva (in an interview with Novaya Gazeta. Patriarch Kirill noted that the only direct path to the revival of our people is the creation of a strong family.

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**Аннотация.** Возрождение ценностей православной семьи исследуется как способ преодоления духовного кризиса в современной России.

**Ключевые слова:** духовно-нравственная сфера, неразвитость духовных интересов, снижение культурного уровня

**Annotation.** The revival of the values of the Orthodox family is studied as a way to overcome the spiritual crisis in modern Russia.

**Keywords:** spiritual and moral sphere, underdevelopment of spiritual interests, decline in cultural level.

UDC 93/94

## THE T-34 WAS A WAR-WINNING TANK

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**Introduction.** We are going to celebrate one the most important dates in the history of our country the 75th anniversary of the Victory in the Great Patriotic War. It is hard to find a family in our country which did not loose somebody in that war. The Great Patriotic war began in 1941 and lasted for 4 years. Soviet engineers had to develop many weapons to defend the country. For example, it was necessary to produce tanks for the army.

The T-34 tank has become the symbol of the Great Patriotic war. We know about it because we are interested of History.

**The purpose** of this work is to describe the tank T-34.

**From the history.** The history of the tank began in 1937. The designer of the T-34 is Mikhail Koshkin. The first tests of the tank were in 1940. The main production of the T-34 was organize in the Urals and Siberia. 61000 tanks were released during the war. Many countries are still armed with T34s even today. Our Russian T-34 tanks were able to win the war over Germany thanks to their superior numbers.

The tank crew consists of four members – a driver-mechanic, a wireless operator, and a loader with a commander-gunner, who were in a double tower.

**Technical specifications:**

Armored housing: **steel**

The combat weight: **32 tons**

Length: **5.92 m**

Length with gun: **8.1 m**

Width: **3 m**

Height: **2.72 m**

Maximum speed: **54 km/h**

Engine power: **500 HP**

Track width: **550 mm**

**The largest tank battle** of the Great Patriotic War was near Prokhorovka. About **800** the soviet tanks took part in it. The T-34 Was a War-Winning Tank. Thus, the T-34 tank was designed in1937, than modernized and adopted. T-34 tank was used as a powerful military weapon during the Great Patriotic War.

**Tankers Heroes.** Tank troops played a decisive role in the victory of our country in the Great Patriotic War. There are many stories about the feat of Soviet tankmen. However, among them there are several outstanding. I want to talk about them.

Senior Lieutenant Kolobanov Zinovy Grigoryevich is the commander of a company of tanks, he destroyed 22 German tanks in one battle.

Guard Senior Lieutenant Lavrienko Dmitry Fedorovich knocked out 52 enemy tanks in 28 battles, was posthumously enlisted in the lists of personnel of units and divisions of the 1st Guards Tank Brigade.

Lieutenant Konovalov Semyon set fire to 16 tanks, 2 armored vehicles, 8 enemy vehicles on a tank in one battle.

We low bow to the Heroes who did everything possible for this Victory! Happy Victory Day!

The heroism of Soviet tankmen can only be expressed in Russian. Australian choir Dustyesky sings a song of war years dedicated to Soviet tankmen.

**Аннотация.** Целью данной работы является описание истории танка Т-34. Охарактеризованы технические характеристики. Рассказано о подвигах танкистов-героев.

**Ключевые слова:** Великая Отечественная война, танк Т-34, герои, Советская Армия.

**Annotation.** The purpose of this work is to describe the tank T-34. Technical specifications are presented. Tankers Heroes are listed.

**Keywords:** the Great Patriotic War, tank T-34, heroes, Soviet Army.

## SECTION 5: MARINE TECHNOLOGIES



UDC 94

### THE EXAMPLES OF RUSSIAN AND GERMAN MARINES IN WORLD WAR II

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**Introduction.** War brings massive destructions and many deaths to our world. Nonetheless, every war and every human's possibility to kill his own kind brings great technological progress to every sphere of people's life.

In this work I want to show a little piece of that great technological breakthrough that great people have done not so long ago.

The aim of this work is to mention the role of marines in Victory.

**Materials and methods.** The main method was an analysis of available literature [1, 2].

**Results.** The "Gangut" is the Russian and Soviet battleship and is the last of the "Sevastopol" dreadnought series. The battleship dreadnought "Gangut" became the fourth ship of the Russian fleet, named after the victory in the Gangut battle. It was founded in 1909 and the construction was over in 1911. The main constructor was Lev Lvovich Koromaldi.

Lev Lvovich Koromaldi is the Russian ship builder, designer and constructor. He was born in 1870 and graduated Nikolaev Marine Academy in 1896. In 1909 at the Admiralty plant Koromaldi laid the battleship Gangut which was launched on September 24, 1911. His main achievement is that he was the first one to analyze the effect of armoring to buoyancy [6, 5, 7].

Let us turn to the opposite side of the conflict just to overview the whole picture of war.

The Bismarck is the German battleship and it is one of the most famous ships of World War 2. It was built in 1939 in Hamburg by Blohm & Voss.

The Bismarck was built later than the Gangut and, obviously, it was more advanced: it was bigger, faster and can carry aircraft on board. At the same time, the Gangut was more armed and had mine artillery and torpedo weapons on board [4].

**Discussion and conclusions.** Truly, the Gangut was very technological according to the time when it was built, which can be approved by the fact that it was used even in World War 2 [3, 8]. At the same time, opposite side had the Bismarck, which was as an ordinary ship but very useful.

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**Annotation.** The Gangut is the Russian ship, which was built before World War 2 by Lev Lvovich Koromaldi, who was the Russian shipbuilder and designer. Gangut was also used actively in World War 2. In comparison to it the German ship Bismarck was built in that period of time.

**Keywords.** Ship, comparison, Gangut, Bismarck, Koromaldi.

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**Introduction.** Trade by sea must continue to flow to maintain the provision goods despite the situation global situation arising from the COVID-19 pandemic. “Customs administrations and port state authorities must continue to facilitate the cross-border movement of vital medical supplies and equipment, critical agricultural products, and other goods, to help minimize the overall impact of the COVID-19 pandemic on economies and societies” [5, www]. Container delivery is one of the most profitable and convenient, which provides the transportation of oversized cargo at an affordable price [2].

**Main part.** The container revolution was a turning point in the development of infrastructure and technology of sea and river ports, construction of dry ports, and modernization of transshipment equipment and vessels [4]. Working with containers made it possible to significantly speed up loading and unloading operations in ports and increase labor productivity. The downtime of a ship in port during loading and unloading operations has also been reduced, from an average of 2-3 weeks to 18 hours. ISO containers are commonly used in shipping as special cargo ships for the transport of goods in containers (TEU). The history of the container fleet dates back to the middle of the last century. It was in the 1950s that part of the bulk carriers and tankers was converted for shipping containers by sea. The ship, rebuilt from an oil tanker laid down during the Second World War, proved to be an ideal means for transporting containers. Such ships became the first container ships, in those days they could carry up to 1000 TEU. However, cellular container ships began to appear only in the 70s, when containers gained popularity in cargo transportation. PANAMAX type vessels have been manufactured since 1980 and could intervene in 5000 containers.

PANAMAX ships were replaced by POST-PANAMAX ships. The first such vessel was the Regina Maersk, launched in 1996. POST-PANAMAX type container ships have a capacity of about 9000 TEU. However, the most capacious are SUEZ-MAX ULTRA LARGE CONTAINER SHIPS vessels, with a capacity of more than 12,000 TEU. Container carriers of this type have been produced since the 2000s. And what are the main development prospects of standard container ship?

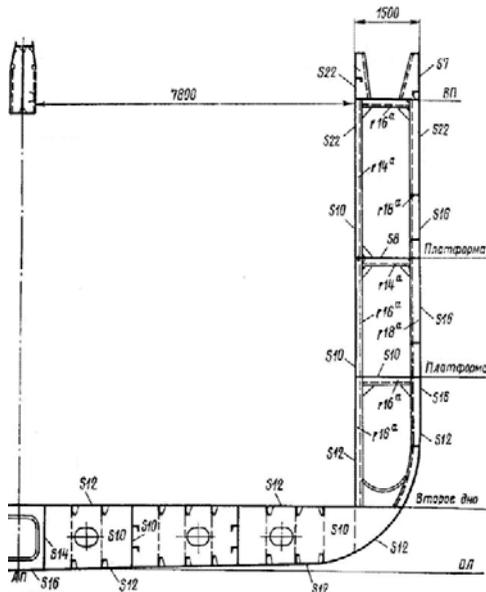
To define the main prospect of container ship development one should consider the classification of container ships and architectural and design features.

The standard container ship is a large vessel with a length of 70 to 400 meters. Thanks to full automation, container ships do not require a large number of crew. Usually the team is 10-20 people. The cargo holds of container ships are equipped with vertical guides, which allows you to load containers strictly on top of each other, do not let them move during transportation. The upper deck of the container ship is also the container loading point. For fixation, containers on the upper deck are fastened with special fasteners or cables. When loading, the proportion between containers in the hold and on the upper deck is respected and is one in three. The staff rooms are on a high superstructure so that the containers do not obscure the view. Container ships have a large deck opening ratio of 80-85%. This is achieved by installing paired or triple manhole covers in width. From a safety point of view, a complex problem for a container ship is ensuring stability under different loading options. Therefore, not only tanks of the second bottom, but also onboard tanks are used to place fuel and water. The location of the fuel and ballast tanks in the area of the second bottom is made in a checkerboard pattern, which allows for differentiation of the vessel in any operating conditions of the vessel [1].

#### 4. Classification of container ships:

- Handysize Class: 260–1000 TEU;
- Handymax Class: 1000–1700 TEU;
- Feeder Class: 1700–2500 TEU;
- Sub-Panamax Class: 2500-4000 TEU;
- Panamax Class container ships: 4000–7000 TEU;
- Post-Panamax Class container ships: 7000-3000 TEU;
- container ships Super-Post-Panamax Class / E-class: more than 13000 TEU;
- Triple E-class container ships: 18,000 TEU [1].

5. To facilitate the loading of bulky goods, the dimensions of the hatches are made close to the dimensions of the holds. Almost the entire width of the deck, with the exception of deck stringers, is occupied by cargo hatches. Along the length of the vessel in the area of cargo holds, hatches have jumpers between themselves, often just one spacing. The presence of the second bottom of the container ship provides increased longitudinal strength. Cargo cranes are often not installed on a container ship, since loading and unloading are carried out in special ports. Figure 1 shows the midsection frame of the container ship “Alexander Fadeev”.



Source: <https://helpiks.org/1-129691.html>

Figure 1 - Midship-changer of a container ship “Alexander Fadeev”.

6. Container carriers are one of the most popular means of cargo transportation, therefore, there is an active modernization and introduction of new types of vessels with an increased capacity of containers [3].

So the 2020s, the capacity of vessels of the ULCS type can reach 28,000 TEU, but due to their large size they will not be able to pass the Suez Canal. An increase in the number of containers will serve to reduce transportation costs, as well as accelerate cargo turnover.

**Conclusion.** Container ships are a promising option for transporting many types of cargo due to the large capacity and cheap loading/unloading system. This article discusses the main provisions related to the history, characteristics, architectural and structural features and classification of the ship.

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**Аннотация.** Актуальность данной статьи заключается в противоречии между необходимостью в грузоперевозках, в рамках развития мирового рынка и отсутствием достаточно компактной и дешевой системы выгрузки/загрузки. На данный момент 80% мировой торговли обеспечивается именно морской транспорт. Контейнеровозы являются перспективным вариантом перевозки многих видов груза. Благодаря большой вместимости и дешевой системе выгрузки/загрузки, контейнеровозы актуальны для грузоперевозок. В данной статье рассмотрены основные положения, связанные с историей, характеристикой, архитектурно-конструктивными особенностями и классификацией судна.

**Ключевые слова:** груз, контейнерный флот, выгрузка/загрузка, контейнеровоз, вместимость, ускорение грузооборота.

**Annotation.** The relevance of this article lies in the contradiction between the need for cargo transportation, within the framework of the development of the world market, and the lack of a sufficiently compact and cheap unloading/loading system. At the moment, 80% of world trade is provided by sea transport. Container ships are a promising option for transporting many types of cargo. Due to the large capacity and cheap loading/unloading system, container ships are relevant for cargo transportation. This article discusses the main provisions related to the history, characteristics, architectural and structural features and classification of the ship.

**Keywords:** cargo, container fleet, unloading/loading, container ship, capacity, acceleration of cargo turnover.

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## THE EVOLUTION OF LIFESAVING EQUIPMENT

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**Introduction.** A significant role concerning safety of life at sea plays life saving equipment carried on board a ship. It is important to increase the reliability of ships and structures due to improvement of navigational equipment and means of fire protection.

As we know, there are collective and individual life-saving appliances. Individual means are life-jackets, lifebuoys. Collective means of protection are lifeboats and life rafts which are commonly widespread.

Modern lifeboats provide the best living conditions for sailor when the vessel is in distress. These boats must be fully enclosed for protecting people in case of low temperatures, strong winds and waves. In case of capsizing such lifeboat should be uprighted immediately.

Thus, lifeboats look like a shelter for sailors in distress. But we mustn't forget that very often rescue operations are carried out during heavy weather conditions. The vessel suffers from pitching and rolling and it is difficult to launch a lifeboat with people inside.

**The main part.** The first Free Fall Lifeboats appeared in 1976. They were designed for 40 people. Further development of using Free Fall Lifeboats was approved by the Norwegian Parliament in 1977 [3].

According to the new design such lifeboat must be attached to the deck of the platform at angle of 56 °. The boat is launched vertically with running engine. After the contact with water the lifeboat has horizontal speed, which allows to abandon vessel very quickly and to save seaman's life. The embarkment is carried out through large hatches located from both sides. The boat is equipped with compressed air cylinders, which are used to maintain the pressure inside the life-saving equipment to prevent leakage of gases and smoke when passing through a zone of burning oil.

The first eight boats of this type were designed for launching from the height of 20m, were installed on one of the world's largest offshore drilling platforms "Dive Delta". Nowadays, the Harding company has developed and successfully tested a new project of lifeboat, suitable for launching from a height of 30 m. The capacity of the boat is 70 people, weight 25 t [1].

A lot of people have a question if it is possible to be alive after launching from such height. We must draw your attention to the fact that period of launching is some seconds and the sailors are sitting in soft high chairs. According to the doctors' investigations the position of human bodies is the most favorable. The pressure of the chair is evenly distributed over all parts of the body.

Modern ships must have at least one lifeboat with the capacity of 2 times more than the number of crew. It is located in the aft. It was proven that the launching of Free Fall Lifeboats is safer than by using traditional way. The release mechanism is simple and reliable. Even in case of engine breakdown the lifeboat will be at a safe distance from the vessel in distress due to kinetic energy [2]. It is interesting to know that a lot of captains, navigators, ship engineers, and sailors wanted to have such kind of lifesaving equipment on board.

Speaking about the next type of lifesaving equipment we mustn't forget that people can make mistakes. At sea such mistakes can cause serious consequences such as capsizing and falling a person overboard. You know that wet clothes reduce our movements, we become so weak due to cold water and it is difficult not to sink without individual lifesaving equipment.

According to statistics, more than 90% of fatal cases at sea occur due to neglecting of lifesaving equipment. Therefore, according to the Maritime Register, any vessel must have sufficient number of individual means which equals to the number of crew members and passengers. There is no exception for small vessels such as yachts and boats of all classes. Today there is a large number of various individual life-saving appliances of various designs: lifebuoys, lifejackets, lines.

We know that in ancient times people used inflated goatskin bags for crossing the river. Also they used lifelines for recovering person from the water.

In 1914, the sailor Vasili Aleksandrov saved people who were overboard with a help of lifeline. In honor of this Russian sailor, the life line received the name " Aleksandrov's line." It consists of a floating synthetic cable, which has a loop with a diameter of about half a meter at the end; two or three orange or red corks. Also it has a small tarpaulin bag with sand for a greater distance of throwing. Nowadays there are different hand-held guns [1].

The third type of lifesaving equipment is a lifebuoy. Many scientists say that it was Leonardo da Vinci who invented a lifebuoy. The Italian could not ignore such a problem as safety equipment for sailors. The lifebuoy was officially approved and used on board in 1915, after the beginning of the First World War. It was due to a terrible catastrophe off the coast of Ireland. In May 1915, a German submarine destroyed the Lusitania British passenger liner. Almost 1,200 people became victims of this tragedy. The main cause of the disaster was that the ship's list was too heavy that it was impossible to launch lifeboats. Thus, lifebuoys should comply with SOLAS requirements:

1. They should be placed on both sides of the ship, weather decks extending to the side of the ship; and at least one should be placed near the stern;

2. Lifebuoys should be fixed in such way to provide quick releasing.

At least one lifebuoy on each side of the vessel must be equipped with a floating lifeline according to the prescribed Code.

At least half of the total number of lifebuoys should be equipped with light-and-smoke buoys; at least two of these lights must also be equipped with self-activating smoke signals. Each lifebuoy should have capital letters of the Latin alphabet with the name of the vessel on which it is transported and the port of registry of a vessel.

Now let's consider the number of lifebuoys according to the SOLAS Convention.

Length of a vessel (m)	Minimal number of lifebuoys
Less than 100	8
100 and less than 150	10
150 and less than 200	12
200 and more	14

Each life buoy must:

- have an outer diameter not more than 800 mm and an inner diameter at least 400 mm;

- be made of unsinkable material such as polystyrene, foam or other synthetic foam which does not absorb water.

- be able to maintain at least 14.5 kg of iron in fresh water for 24 hours;

- be at least 2.5 kg;

- not maintain combustion or melting after being in fire for 2 seconds.

Speaking about life- jackets we'd like to draw your attention that they were patented in the 40s of the XIX century, and by the beginning of the XX they had already become widely used by n American ships. All ships should be obliged to have life jackets for every person on board. In the mid 20th century uniform standards were adopted. The basic requirements for lifejackets are the following:

- they must give an opportunity for unconsciousness person to be face up;

- they must keep person's face at a height of at least 12 cm from the water level;

- they must not constrict one's movements.

- they must have search light, marine battery, whistle, reflective stripes, test seal and marking [1].

There are many types of life-jackets and some of them are dangerous for use due to obsolete construction. To avoid problems at sea we must follow the instructions for using a life-jacket. The most famous tragedy which occurred at sea and had a lot of casualties due to lack and improper putting on life-jackets happened with the ocean liner “Titanic”.

Immersion suits and thermal protective equipment are very popular nowadays. The main disadvantage of lifejackets is the complete lack of thermal protection, so people’s life in distress depend on the temperature of sea water and is counted in minutes in winter. In accordance with international requirements only persons working on board rescue vessel are provided with immersion suits.

Immersion suits should comply with the main requirements:

- they should be put on not more than 2 minutes;
- they should protect all the body except the face;
- they must have reflective stripes, lifeline, signal light, signal whistle and life belt with a carbine;
- they should provide being at low temperatures for a long period.

**Conclusion.** Thus, we make a conclusion that lifesaving equipment was used and changed from ancient times. It is necessary to provide the safety of life at sea. We suppose that our scientists will do their best for improvement of such equipment and decreasing deaths at sea.

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**Аннотация.** В статье рассматриваются различные виды спасательного оборудования необходимые для обеспечения безопасности жизни в море; история их возникновения и эволюция с древних времен; перечисляются основные требования к спасательным средствам, их количество на борту судов и дальнейшие перспективы в использовании.

**Ключевые слова:** спасательное оборудование; спасательная шлюпка; спасательный жилет; гидрокостюм; судно , терпящее бедствие.

**Annotation.** The paper studies different types of lifesaving equipment which are necessary for providing safety of life at sea; the

history of their origin and evolution from ancient times; also the number of lifesaving equipment on board a vessel, the main requirements and further development are listed.

**Keywords:** Lifesaving equipment; lifeboat; life-jacket; immersion suit; vessel in distress.

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## **INTERMODAL TRANSPORT AS A MODERN CHALLENGE**

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**Introduction.** Nowadays the intermodal transports occupy an important place in the development of new transport technologies. Intermodal transportation may be defined as the transportation of a person or a load from its origin to its destination by a sequence of at least two transportation modes, the transfer from one mode to the next being performed at an intermodal terminal" [1, p. 2].

Reviews on these issues may be found in T.G. Crainic [1], B.Gendron, J.-Y. Potvin, P.Soriano [2], A. Imai, E. Nishimura, S. Papadimitriou [3], M. JonVerma, V. Verter [4], K.H. Kim, H.B. Kim [5], D.C. Mattfeld, and H. Kopfer [6], M.B. Pedersen, T.G. Crainic, O.B.G.Madsen [7], W.B. Powell [8], D. Steenken, S. Vob, R. Stahlbock [9].

**Materials and methods.** Methods of theoretical level as axiomatic, formalization, abstraction, general logical methods (analysis, synthesis, induction, deduction, analogy) are used in the study. Some facts from history have been studied within the framework of this problem. The comparative method was used; this is a method of comparing historical facts, contributions of historical figures, which is aimed at detecting analogies or their absence in the historical process. In this case, additions or corrections to existing knowledge may acquire true scientific value. Systematization of historical knowledge on the basis of a comparative method that allows to find similarities or identify differences in historical processes and phenomena, bring together and group historical facts in a new way, makes it possible to obtain new research results and make "non-traditional" scientific conclusions about the development of technologies.

**The results of the study.** In the first half of the 20th century, a transportation around the world was a problem, goods were loaded into bags, boxes and barrels; all things were manually rolled, shifted and lifted onto a cargo ship. Thus it was slow, expensive and dangerous for the cargo, because workers could break or steal the cargo. But the bigger problem was that the ships were at sea only half the time, and the rest of one they were in port on loading with absence of revenue. These are the reasons why everything produced in other countries and continents cost much more.

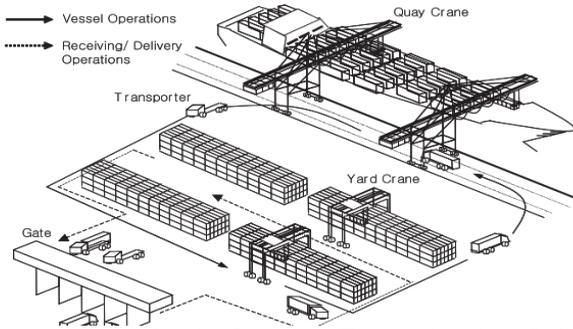
We'll presents some fact from the history of transportation. All this was changed by one man, Malcolm McLean, in 1956; now have phones, fresh vegetables and fruits, food and drinks from all over the world. It took one simple invention that changed the whole world: simple iron containers.

Malcolm McLean was a truck driver in the 30s, waiting for his turn at the port for a day, watching the work of the movers. He thought about cargo truck disconnecting and lifting onto the ship hundreds of such trailers. It took him 20 years to save up money and buy the World War II tanker "Ideal x", where he have tested his idea.

In 1956, an event occurred that defined the world's globalization. A vessel with 51 containers has dispatched. Upon arrival, the containers were loaded onto trucks and delivered to the recipients. If previously loading one ton of cargo cost 6 dollars, now it has become 16 cents, saving 37 times. No other mode of transport could deliver cargo so cheaply. It became clear that containers were the future solution of the problem. At last one standard for all containers was choose: a twenty-pound container with 2 cars, 168 tires, 200 mattresses, 10,000 bottles of wine or half a million eggs.

Every port in the world is equipped with such containers; there are also special ones for bulk cargo with a lock at the bottom, for liquids and gases in tanks, as well as refrigerator ones.

But the metal boxes could not change the economy; it was intermodality that changed it. This is the idea on which the entire logistics of transportation is based, as soon as the cargo arrives at the port, it is removed by a crane and immediately put on a train or truck, without unloading the container. All over the world, the standard form of attachment, the delivery process from the port to the recipient: delivering, , mounting, dispatching. Containers are brought to the port, stacked on top of each other as a constructor, the hold is closed with a lid and the deck is loaded with containers (Picture 1).



Picture 1 – Example of a Container Terminal with an Indirect Transfer System (Park 2003).

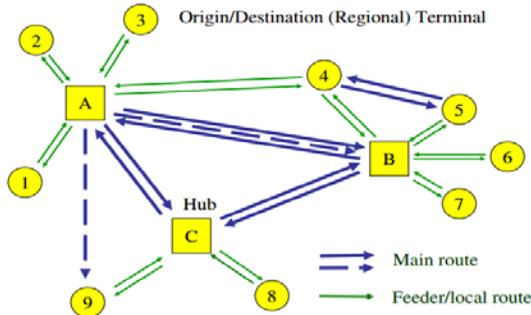
Source: [1].

A container yard consists of blocks of containers, which are separated by aisles for transporters as shown in Figure 2. A block consists of 25 to 35 yard bays, and a yard bay has 6 to 10 stacks of containers. Container handling and storage operations include the management and handling of containers while they are in storage in the yard and thus occur between the receiving and delivery operations and the ship operations. Container-handling equipment performs the placement of containers into storage and their retrieval when needed

Delivery in our time has come to represent the following algorithm:

Factory– Train– Vessel – Trailer – Shop.

“The relations and trade-offs between volume and frequency of shipping, on the one hand, and the cost, frequency, and delivery time of transportation, on the other hand, often dictates the use of consolidation transportation services” [1, p. 8] (Picture 2).



## Picture 2 – Network with Consolidation Terminals / Hubs

*Source: [1].*

### **Discussion and conclusion.**

Globalization has begun, and the size of ships has started to grow at a huge rate, and their capacity has increased 200 times during 60 years. And such large vessels require a team of several dozen people, the technology has led to the fact that manual labor has not become so demanded in the cargo transportation branch.

In the context of globalization the availability of goods has greatly affected culture, because the accessibility and price of mass-produced goods are the same all over the planet.

Thus, the idea of one person revolutionized international trade. Transportation technology is still improving. Container ships are becoming larger; the average size of these vessels is impressive in its dimensions, the length alone can reach up to 300 meters. Technologies are developing every day to make it more comfortable.

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**Аннотация.** В статье рассматриваются первые проблемы перевозки грузов, зарождение интермодальной перевозки, алгоритм перевозки груза в наше время, изменение судов и актуальность данного вида перевозки.

**Ключевые слова:** Malcolm McLean, интермодальная перевозка, перевозка грузов, контейнер, погрузочно-разгрузочное оборудование для контейнеров, концентратор.

**Annotation.** The article deals with the first problems of cargo transportation, the origin of intermodal transportation, the algorithm of cargo transportation in our time, changes in ships and the relevance of this type of transportation.

**Keywords:** Malcolm McLean, intermodal transportation, cargo transportation, container, container handling equipment, hub.

**Adhesives in marine engineering**

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Abstract: This article is an overview of the use of adhesives in marine engineering. Basic terms for adhesive bonding are defined by a general overview of future technology development that may influence the use of materials and joining methods such as adhesive bonding.

Key words: adhesive bonding, adhesives, ship building, design for adhesive bonding, international regulations.

During the design, fabrication and modification of ships there are innumerable joining tasks to assemble the structure and to install equipment. The vast of the joints are done using welding, bolting or riveting. There are situations where these joining processes are not necessary and cannot be done. This is for lightweight structures based on thin materials. As a reminder, we can't weld steel or composite. However, to be successful, adhesively bonded connections should have sufficient mechanical strength and should be cheap.

What does word “Adhesive” mean? According to Adams et al. (1997), ‘an adhesive can be defined as a polymeric material which, when applied to surfaces, can join them together and resist separation’. Adams and co-workers describe structural adhesives ‘as one used when the load required to cause separation is substantial such that the adhesive provides for the major strength and stiffness of the structure’. The structural members of the joint, which are joined together by the adhesive, are the adherends. Adhesion as such is used widely on marine structures. One example is corrosion prevention coatings. Adhesive bonding could mean that the plates are too thin to weld, a particular material combination that cannot be welded, requirement for smooth surfaces for aesthetic reasons, avoiding fires and high temperature works near fuel lines.

Main idea of usage adhesives is to bring new lightweight materials and lightweight materials into marine engineering. All marine vessels gain sufficient effect of using adherends as jointings.

- The low energy ship. It is anticipated that in order to save weight and hence reduce fuel costs, the use of lightweight and hybrid materials will become more widespread.
- The green-fuelled ship. Significant reductions in emissions such as SOX and particles can be achieved by switching to natural gas. The liquid natural gas (LNG) tanks used today require considerably more space than a diesel tank. New LNG tank concepts are under development using new material combinations to improve the current situation.
- The Arctic ship. Increased operations in the Arctic will require novel evacuation vessels that can also travel over ice, not just water. A number of material and joining issues are anticipated.
- The virtual ship. The use of integrated ship design tools will become more commonplace. This implies that joining processes including adhesive bonding also need to be modelled in the design tools.
- Subsea production. Deployment of much larger subsea processing equipment is predicted, and with it comes the need for larger housing that is both water- and pressure-proof.
- Arctic offshore development. Significant research and development is underway to qualify and characterise materials for the use in Arctic operations. An increase in use of lightweight materials such as composites and aluminium is predicted. This puts tough new requirements on the materials and joining methods such as adhesives, i.e. toughness at low temperatures. However, there is some experience of using adhesives for LNG containment systems at much lower temperatures (at about  $-163^{\circ}\text{C}$ ).

The list above is a discussion of the technology developments identified in DNV's Technology Outlook. It serves as an illustration on how new designs and material choices open up new possibilities for adhesives joining,

There are a lot of actual and potential applications for adhesive bonding in the maritime industry. Most of the are related to the superstructure of a ship. There are two main goals: to repair cracks in aluminium superstructures and to join lightweight structures made of composite or aluminium to the steel hull.

The paper by Reichard (1997) reports on a research project to develop composite superstructures for commercial ship application. He presents an innovative bonding process where adhesive tape and paste adhesive are combined to form the bonded connection between the composite and steel interfaces.

Adhesive bonding is used in outfitting of ships. Bonding of windows, or direct glazing, has become standard practice on passenger ships. The operating experience seems to indicate that there are no issues with adhesive joining (Weitzenböck, 2009).

The usefulness of adhesive bondings can be more efficient if we use it on the blades of large wind turbines. As discussed by Hayman et al. (2008), wind turbine blades are usually assembled from two half-shells and a central web or a main spar (also known as load-carrying box) by adhesive bonding. There is also a repair technique that uses pre-prigs and a UV emitting light diode to accelerate the curing process that was presented by Marsh (2011).

Wind turbine blades are quite different to ship or oil and gas applications when it comes to approval or certification. Adhesive bonding is an integral part of the blade design. It would simply not work without adhesives. There are a number of design guidelines and rules for wind turbine blades; see for example Det Norske Veritas (2010a). The approval regime for the blades is closer to aircraft design than shipbuilding as full scale testing is required to verify static and fatigue performance over a 20 year lifetime.

The identification of hazards and risks is usually done according to the IMO guidelines for formal safety assessment (FSA) (IMO, 2002). It consists of five steps:

- Step 1: Identification of hazards
- Step 2: Risk analysis
- Step 3: Risk control options
- Step 4: Cost benefit assessment
- Step 5: Recommendations for decision making.

In conclusion, adhesive bonding can get a huge success and marine engineering. Standards and rules should be established by marine societies on different levels and be included in shipbuilding process. This decade adhesive can make a huge revolution in ship constructions and increase useful period of joints.

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## SECTION 6: THE ACTUAL PROBLEMS OF ECONOMICS



UDC 336.57

### POSITION OF THE RUSSIAN SOCIAL POLICY AT THE PRESENT STAGE

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**Introduction.** The current state of social support for families with children in Russia is characterized by “the existence of a large list of state benefits fixed at the legislative level” [3, p. 60].

State guarantees (benefits) to families are provided for the implementation of the task of state support for families with children. Thanks for this people are motivated to achieve high birth rates, demographic decline is being overcome in the country and birth rate is increasing. In our country, the questions of protecting motherhood and childhood are put in first place. This is confirmed by the presence and implementation at the state level of various activities that are aimed at supporting families with children.

The modern history of Russia has shown that the questions of providing social assistance and supporting for families with children have always been put at the forefront of all tasks. Therefore, the state of social policy in our country is directly dependent on the demographic situation.

The state increases its authority over citizens by realizing the state function in the sphere of social security and providing state social

assistance, including for families with children. Consequently, the population increasingly trusts the authorities. But the presence of problems in the social security of motherhood and childhood sets the task of improving and modernizing the mechanism for providing state social assistance [1, 2].

**Materials and methods.** The normative legal regulation of social support for motherhood and childhood includes the following main legislative acts:

1. Federal Law of 19.05.1995 №81-FL «About state benefits for citizens with children»
2. Federal Law of 29.12.2006 №255-FL «About compulsory social insurance for temporary disability and in connection with maternity»
3. Federal Law of 29.12.2006 №256-FL «About additional measures of state support to families with children»
4. Federal Law of December 28, 2017 №418-FL «About monthly payments to families with children».
5. Federal Law of 17.07.1999 №178- FL «On State Social Assistance»

In our country, the program of the state social assistance is gradually being improved and modernized: new normative legal acts are adopted, the quantitative data of the provided benefits and guarantees are changed, the «freezing» of funds from maternal (family) capital is canceled from the first of January 2020, the payment of benefits for caring for a child from 1.5-3 years is changed; new monthly payments are introduced, etc.

Maternal (family) capital in Russia – a special type of assistance and state support to families with children, involving an additional measure of social assistance [6]. “In the initial maternal (family) capital was 250 thousand rubles, but at the same time it was indexed to the inflation rate until 2015” [3, p. 61]. From 2015 to 2019 the amount on the maternal (family) capital was not indexed, but amount was a fixed - 453,026 rubles. After a 5 year «freeze» the amount on the maternal (family) capital (from 2015 to 2019), the state decided to conduct indexation the amount on the maternal (family) capital. The amount on the maternal (family) capital at nowadays (from the first of January 2020) is the 466 617 rubles (the indexation is 3%).

The President of the Russian Federation devoted a special place in the annual Messages to the Federal Assembly of the Russian Federation the questions of social policy and support for motherhood and childhood (table 1)

Table 1 – *The main areas of social policy mentioned in the President's Messages in 2019-2020.*

Message from the President in 2019	Message from the President in 2020
OFFERS	
introduction of an additional measure	extension the program of the maternal

of support for families where a third and subsequent child is born	(family) capital until December 31, 2026
the payment of benefits for caring for a child from 1.5-3 years is changed	issuance of a certificate for maternal (family) capital from the birth (adoption) of the first child
	an increasing in maternal (family) capital by another 150 thousand rubles
	introduction of monthly payments for children aged 3-7 years

*Source: Compiled by the author.*

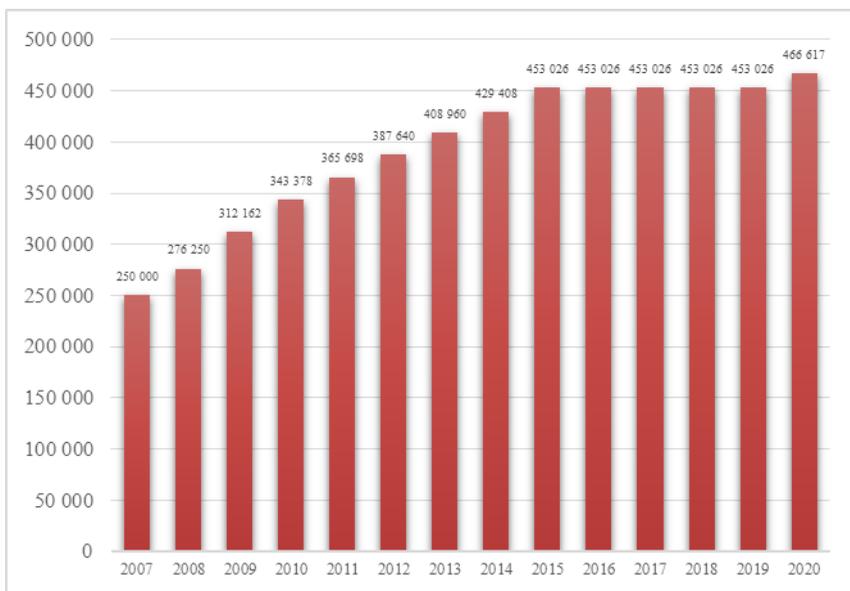
**Results.** The introduction of an additional support measure at the birth of the third and subsequent child involves the payment of 450 thousand rubles directly from the federal budget, which is used to repay the mortgage loan. Also, from the first of January 2020, the payment of benefits for caring for a child from 1.5-3 years is changed: the size began to equal the cost of living per child in the region. It is worth mentioning that since 1994, the childcare allowance has been 50 rubles, the funds of which came not from the budget of public law education, but at the expense of the employer.

Introduction of monthly payments for children aged 3-7 years involves the submitting of financial assistance to families whose incomes do not exceed one living wage per person. At the first stage, this amount will be half the cost of living – 5.5 thousand rubles.

Modification in the amount of the maternal (family) capital in the Russian Federation for 2007-2020 presented in figure 1.

Until December 31, 2019 the state certificate for the maternal (family) capital was granted only after the birth or adoption of the second or subsequent children, but from the first of January 2020 the President of Russia proposed to issue a certificate for the maternal (family) capital already from the birth (adoption) of the first child [5]. At the same time, it was proposed to increase the capital by another 150 thousand rubles, the right to which the family will receive when the second child is born.

Consequently, the total amount of funds in the maternal (family) capital is 616 617 rubles. And this is not yet final, since every year the amount on the maternal (family) capital is most likely to be indexed annually at the inflation rate. It is assumed that the size of the capital in 2021 will be more than 500 thousand rubles.



**Fig. 4 – The amount of the maternal (family) capital in the Russian Federation for 2007-2020. (in rubles)**

*Source: Compiled by the author.*

All these and other types of state assistance in support of motherhood and childhood are important because they are aimed at the citizens of their country - consumers of social policy services of the state.

**Discussion and Conclusions.** However, according to the publication of the «Rossiyskaya Gazeta», the number of the families that do not use the maternal (family) capital is 14%, that is, potential recipients simply do not come to the Pension Fund of the Russian Federation to receive this state social assistance [4].

In this regard, financial education of the population is proposed to increase by advertising in television and radio broadcasting, on the Internet, as well as by issuing booklets (brochures) upon receipt of any state (municipal) service.

It is also necessary that the Pension Fund of the Russian Federation exercise proper control when deciding on the issuance of a state certificate for the maternal (family) capital to recipients, as well as in the process of spending funds. This is due to the fact that there are cases of illegal use (cashing out) of funds on the maternal (family) capital. It is advisable to save documents confirming the use of budget funds according to the state certificate for the maternal (family) capital by users of the maternal (family) capital (improvement of living conditions, education of children, etc.).

In Russia, the program for issuing a certificate for the maternal (family) capital is being implemented both at the federal and regional levels. However, not all 85 regions of the Russian Federation have own the regional program: somewhere it was launched and subsequently suspended; in some regions there was no need for implementation. This is due to the fact that one or another regions, within the framework of its regional social policy and the availability of its own financial resources, independently decides on the realizing or stopping of the program for the maternal (family) capital.

In this regard, it is proposed to create the program for the maternal (family) capital in all regions of the Russian Federation in addition to the federal maternal (family) capital, as well as to restore this regional program in those territories of the Russian Federation in which it ceased to operate for any reason.

Thus, the position of social support for families with children in Russia is at a high level, but gaps and a number of measures are required to improve the efficiency of budget expenditures. It seems that the set of measures proposed by the author will improve the demographic situation in the Russian Federation.

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**Аннотация.** В статье освещается механизм социальной поддержки материнства и детства в нашей стране, представляется анализ мер, внедряемых в социальном обеспечении для семей с детьми, предложенные в Посланиях Президента Российской

Федерации Федеральному Собранию в 2019-2020 гг. Особое внимание в статье уделено материнскому (семейному) капиталу, его состоянию в 2019-2020 гг.

**Ключевые слова:** государственная социальная поддержка, государственные пособия, социальная политика, материнский капитал, федеральный бюджет

**Annotation:** The article highlights the mechanism of social support for motherhood and childhood in our country, presents an analysis of the measures introduced in social security for families with children, proposed in the messages of the President of the Russian Federation to the Federal Assembly in 2019-2020. Particular attention in the article is paid to maternal (family) capital, its condition in 2019-2020.

**Keywords:** state social support, state benefits, social policy, maternity capital, federal budget.

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## TO THE QUESTION OF ENSURING SOCIAL JUSTICE IN THE RUSSIAN FEDERATION

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**The purpose of the study** is to develop recommendations for equalizing social inequality in the Russian regions, and the possibility of achieving social justice in modern Russia.

**Materials and methods.** The study was conducted on the basis of published research materials that allow us to determine the diversity of concepts of social justice, to create a socially just society, and also to identify the main features of social protection of the population in Russia. When conducting research, the following methods were used: empirical (collection and analysis of scientific publications, literature on the problem), general scientific, comparative, statistical.

When asked whether the existence of equality of rights is a sufficient condition for the creation of a socially just society, Socrates, Plato, Aristotle tried to answer. According to the author, the problem of social justice cannot be solved in principle, since in any society, there is a distribution of material goods, which undoubtedly leads to the stratification of society.

Thanks to the USSR and a number of developing countries, the term "social justice", as a synonym for the concept of "protecting human rights", was included by the UN in the Declaration on Social Progress and Development, adopted in 1969. Since 2006, the UN has viewed social justice as "a fair and compassionate distribution of the fruits of economic growth ..."

The concept of social justice depends not only on the political system and economic model of the state. In any country, different social strata of the population have their own concept and vision of social justice, which means that the level of income of citizens and the level of social inequality between them are of no small importance.

The practical implementation by the state of social policy in the context of social justice, in modern society, is carried out mainly through taxation, social insurance and through government spending on social policy in the field of health, education, protection of rights and labor law.

An analysis of the consequences of the global financial crisis of 2008 revealed the weaknesses of state regulation of social protection of citizens, regardless of the social policy model, which led to the need to review the fundamental foundations, and to determine the balance of interests between state financial provision of social guarantees and private business.

An analysis of the situation with ensuring social justice in Russia showed an insufficient level of effectiveness of the actions of the executive authorities to achieve the standard of living of citizens and ensure equal opportunities for the development of the individual. T. Moskalkova in her report notes the existence of a gap "between constitutional norms on human rights and freedoms and the practice of their implementation"<sup>1</sup>.

According to the author, at different income levels of citizens, which is a natural process in a modern economic society, the attitude to understanding social justice will be the same for all citizens, provided that the distribution system in society is supported by most citizens, and this will be considered an undeniable norm.

According to the results of a VCIOM survey on November 23, 2018, Russians' opinions on how to achieve social justice in Russia, only 16% of citizens said that society has become more socially fair, 54% of Russians said that no changes are taking place, and 28% of respondents stated that the changes are not happening for the better. For 5 years, the share of Russians supporting the social policy of the state increased slightly from 20% in 2013 to 29% in 2018, while 32% of those polled believe that the authorities impede the establishment of social justice in society. As measures to ensure

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<sup>1</sup> T. Moskalkova. Report [Electronic resource].- Access mode: <http://kremlin.ru/events/president/news/60720> (accessed 12.05.2020)

social justice, the predominant share of Russians noted the fight against corruption as “the law is one for all” (14%), and only 4% of respondents noted the need for economic development and strengthening social policy.<sup>2</sup>

Social inequality is especially noticeable in the regions of Russia, which are characterized by uneven differentiation of socio-economic development, and is directly dependent on the state of the regional economy. Inefficiency in the use of labor resources affects the unemployment rate, helps to increase the territorial imbalance of labor supply and demand, helps to increase regional differentiation in terms of living standards, widening the gap between the population’s income.

So, in 2005, the gap between the most and least well-off regions of Russia in terms of GRP per capita, the gap was 54,79% (Khanty-Mansi Autonomous Okrug – 955182,9, Republic of Ingushetia – 17435,1), starting in 2010 until 2014, the gap gradually decreased by almost 2 times, but since 2015, it has grown backwards, and already in 2019 the value is 39,89% (Yamalo-Nenets Autonomous Okrug – 4581150,1, Republic of Ingushetia – 114844,1).

Despite the measures taken by the Government, the problem of equalizing the economic level of the regions remains acute.

The social policy of the state is expressed in a system of social protection measures, the purpose of which is to provide state guarantees of constitutional human rights to achieve a standard of living that meets the minimum social needs of a person and guarantees his rights, regardless of place of residence, religion, nationality, gender and age.

Social protection policy is a system of legislative acts, measures and norms applied by the government to create favorable living conditions for citizens, guarantees of state support in case of increased social risks [3].

The system of measures of social protection is a tool for implementing the main directions of social policy of the state, and is designed to provide material protection of human rights, support for the poor and those in need of help categories of the population, the implementation of which is carried out on the basis of regulatory legal acts, with the help of monetary and material resources.

In his study, Demchenko S.G., Vereshchagina A.V., Samygin S.I., note that Russian society, being in a situation of universal survival, "in the absence of incentives and motivation to mobilize efforts, as happens, for example, during a war or other tragic social events that threaten life of the whole society”, it is not able to “resist the destructive influences of the

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<sup>2</sup> Social justice in Russia. [Electronic resource].- Access mode <https://wciom.ru/index.php?id=236&uid=9443> (accessed 12.05.2020)

external and internal environment ”, as it focuses on providing daily needs that do not go beyond the framework of individual life [4].

O.N. Yanitsky calls Russian society as one of general distrust, and mass distrust causes a high level of uncertainty of social relations and interactions, which is unsafe for society in its consequences [10].

According to the author, the share of needy Russians is not declining, while representatives of big business, top management of state corporations, and ordinary government officials lead a luxurious lifestyle. The gap takes on such a significant shape that the state's social assistance to needy citizens does not allow it to be leveled.

The author believes that the effectiveness of social payments and benefits should be determined by the level of financing of the recipient's current needs at the expense of social payments, characterizing the indicator of the quality of life of the recipient of payments, and not by the level of replacement of lost income, in the event of an insurance event.

Comparing revenues and expenditures of state (consolidated) budgets of world countries for 2016, we note that the share of government spending in Russia's GDP (37.8%) is 3-4 times higher than the share of government spending in developed countries, which is a characteristic indicator for most developing countries [9].

The exception is Argentina, where the share of government spending in the structure of the consolidated budget exceeds Russian indicators (44,6%). At the same time, the share of social protection spending in Russia is 32,8%, in Germany 43,2%, in Austria and Italy 42,6%, 42,8%, respectively [9].

The share of expenditures in Russia on education (2,2%) and healthcare (3,4%) is negligible compared to the share of expenditures in the consolidated budgets of developed countries exceeding the figure of 15% [9].

According to one of the theoretical areas of research, the basis for a high share of expenditures on public administration is the assumption that with the growth of well-being of the population, the value of consumption of public goods grows.

But there is another opinion, according to which, excessive bureaucracy and the presence of one's own interests lead to an increase in the volume of public goods provided.

According to the author, in Russia, corruption plays an important role, as well as the absence of strict measures to suppress it.

To effectively combat social inequality, there is no universal way to solve this problem, due to differences in socio-economic development of countries.

Fiscal policy plays a major role in the implementation of state policy on the redistribution of wealth between people, regions and generations, and

depends on it the implementation of social security programs, the amount of social spending, which in 18 OECD countries increased from 18 percent of GDP in 1980 up to 26% of GDP in 2014 [11].

The problematic issues of public administration include certain difficulties in assessing their effectiveness, due to the lack of a methodology for evaluating the effectiveness and determining the success of state educational, systems or activities in the field of health [12].

Problems of the effectiveness of social protection of the population are actively studied in the scientific community.

Some researchers believe that it is necessary to simplify the system of providing social support to the poor as much as possible. So, V. Bobkov, believes that one of the possible directions of reforming the system of providing social assistance to the needy is to simplify it as much as possible, as well as transferring the social assistance system not belonging to the category of needy on an insurance basis.

V.A. Sidorova notes that often, “recipients of social transfers are not classified as poor. At the same time, a part of the population in need of help does not receive it” [7, p. 86].

Others suggest the introduction of new measures, such as: assessing the applicants' need for social assistance. To this end, it is proposed to develop universal rules, uniform criteria for testing poverty; reliability and completeness of information on income and property of applicants. So, for example, Nazarov V.S. believes that “measures are needed to reduce dependency, to introduce conditions and programs for supporting labor incomes of recipients of social assistance” [5, p.140].

As a primary measure Kh. M. Khadzhalova proposes to reduce the unjustified differentiation in remuneration between commercial and budgetary spheres, between various areas of activity financed from budgetary funds, which would remove social tension in society [8].

The issue of introducing a progressive taxation scale is most relevant, especially as a measure to reduce social tension in society.

For example, Balynin I.V., in order to achieve social justice, using the example of international experience of the countries of Austria, Germany, Luxembourg, it was proposed to establish a progressive taxation scale. For individuals with a salary of up to 10 600 rubles. - exempt from tax, up to 25 000,0 rubles. introduce preferential rates of 5 and 10%, over 25 000,0 rubles. - leave the rate of 13%; for high incomes, set a differential rate of 15-19% [1] [2].

Adapting the world's best practices to fit the national state of the economy would have positive prospects for Russia.

Positive results in this matter were achieved by France, which established a minimum wage rate for all employers, taking into account its indexation, which allows satisfying the daily needs of citizens [6].

## **Results.**

Based on the results of the study, the author proposed the following measures to equalize the social inequality of regions:

– for representatives of state corporations, government officials, and companies with an organization's income level exceeding a certain cut-off threshold, establish an allowable fixed wage difference between lower-level personnel and senior management (no more than three, four times), settle it by labor legislation.

– develop a methodology for assessing the effectiveness of the provision of benefits and social guarantees to needy citizens.

– to level social inequality, to ensure the involvement of business in the social sphere, on the terms of public-private partnership.

## **Discussion and conclusions.**

The implementation of the measures proposed by the author will increase confidence in the government and its course towards the implementation of social policy.

The establishment of threshold values, and a fixed raising coefficient of labor remuneration, depending on the level of staff qualification and the vertical hierarchy, will be a tool to reduce social tension and smooth out the difference in incomes of citizens.

Unified rules for the provision of social benefits are able to provide a fair distribution system, and the construction of a socially just society.

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**Annotation.** The article considers the situation of ensuring social justice, and identifies the possibilities of achieving it in modern Russia, for creating a socially just society. Particular attention is paid to the high differentiation of incomes of the population and the effectiveness of the existing system of social protection of the population, which confirms the need to improve the distribution system, thereby determining the relevance of the study.

To solve the identified problems and achieve social justice, the author proposed a set of measures.

**Keywords:** social justice, region, models of social justice, social policy, social protection.

**Аннотация.** В статье рассмотрена ситуация по обеспечению социальной справедливости, и определены возможности ее достижения в современной России, для создания социально-справедливого общества. Особое внимание в работе уделяется высокой дифференциации доходов населения, и эффективности существующей системы социальной защиты населения, что подтверждает необходимость совершенствования распределительной системы, тем самым, определяя актуальность проведенного исследования.

Для решения выявленных проблем, и достижения социальной справедливости, автором предложен комплекс мер.

**Ключевые слова:** социальная справедливость, регион, модели социальной справедливости, социальная политика, социальная защита.

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## **HOW TO INCREASE THE EFFECTIVENESS OF FISCAL POLICY IN THE FIELD OF SPENDING ON AN INNOVATIVE ECONOMY?**

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**Introduction.** Innovations play an important role in the development of the country and directly affect its economic growth. Countries with

developed innovative potential occupy leading positions in the world arena. In this regard, for Russia it is important to overcome the scientific and technological backwardness from leading world countries. The state should act as a stimulator of innovative development, incl. through the using of fiscal policy tools.

**Materials and methods.** To achieve these goals, a set of general scientific and special methods was used. The methods of analysis and synthesis have found particular application.

**Results.** The ideas proposed in the work can be used in the process of forming the innovation policy of the Russian Federation for the coming years, including as part of the use of targeted programming.

Analysis of the current situation in the business environment allows us to identify key trends and areas related to innovation in Russia. So, figure 1 presents the results of the analysis of data on the activities of organizations for 2010-2018.

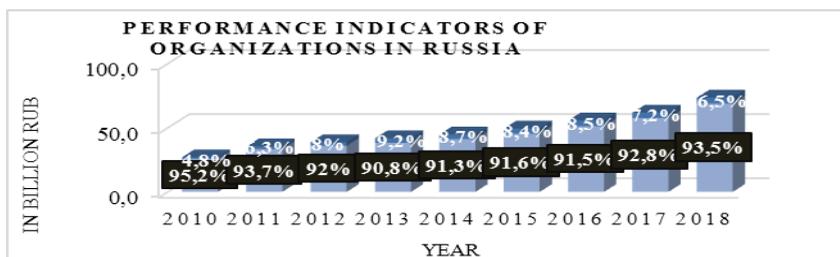


Figure 1– Performance indicators of organizations in Russia

Source: Compiled by the author based on data from Rosstat [1].

The problem of increasing the efficiency of innovation expenditures requires special attention in terms of budget policy development. Analyzing statistical data on the innovative activities of Russian organizations, we note that in 2013-2018. the share of innovative goods, works, services from the total share of sales is reduced. Compared with 2013, the volume of shipped TRU in 2018 decreased by 2.7%. The presented negative trend is observed in a situation where, on the contrary, it is necessary to increase innovative activity. One of the reasons for the negative trend, according to the author, may be an ineffective budget policy in the field of expenditures on an innovative economy.

Based on the analysis of innovative activity, the efficiency of government spending on the development of an innovative economy should be increased. It is important to note that the Budget Code of the Russian Federation enshrines the principle of efficiency, disclosed through cost-effectiveness and efficiency [2].

According to the author, to ensure the implementation of this principle in relation to the costs of an innovative economy, it is necessary to adhere to the following areas:

1) Control over expenditures using target indicators (ensuring monitoring of the effectiveness of budget expenditures, using program-targeted financing).

2) Privileges for venture investors (cost reduction for risky investors can ensure an influx of financial resources into this environment, as well as increase interest in venture investment in general).

3) Support for funding the grant system (the state finances science through a system of scientific grants, financial support attracts research teams. They compete with each other, implement various ideas. It is objectively clear that most of the proposals will not succeed. The objective of this stage is to get an excess of innovative ideas. Further research teams register patents that are acquired by commercial organizations and are used to increase profits, which are subsequently taxed on profit).

4) Development of the system of state orders in the field of innovation;

The leading driver of the widespread generation of innovation and the creation of an innovative economy has become the accumulated high-quality and creative human capital. At present, the flow of the main resource of the knowledge economy, people, is declining in Russia. It should be noted that to build an innovative economy, high-quality human capital is needed. To stimulate its formation, it is rational to strive for the following indicators proposed by the Heritage Foundation (1 indicator) and the author (2-4 indicators):

1) A high index of economic freedom (the level of economic regulation, open markets, the index is compiled by the US strategic research institute - Heritage Foundation) [4].

2) A high level of development of education and science (the ratio of people with higher education in relation to the population, an analysis of the dynamics of the ratio of spending on science and education and the number of organizations engaged in research activities, etc.).

3) High and competitive quality of life (monitoring public opinion about the quality of life, assessing the quality of health care, etc.).

4) Real competition in the economy and high demand for innovation (rule of law, high-quality and effective antitrust regulation, import and export of technology, etc.).

The next step is the analysis of the Decree of the Government of the Russian Federation of April 15, 2014 N 316 (as amended on October 14, 2019) "On the approval of the state program of the Russian Federation". Economic development and innovative economy (including the subprogram "Stimulation of innovations" allocations for the implementation of which at the expense of the federal budget should amount to 162 billion rubles) [3].

Moreover, it is necessary to pay attention that the executive officer is the Ministry of Economic Development. At its core, this ministry is not specialized in this matter. The Department of Strategic Development and Innovation is the only structural unit of this federal executive body that is directly related to innovation, which may adversely affect the quality of execution of the state program. The author considers it important to note that at the federal level there is no authority responsible for innovation and investment. In this regard, the author considers it necessary to establish it, which would make it possible to coordinate individual structural departments and departments in other government bodies. Ultimately, this will improve the efficiency of fiscal policy in the field of innovation.

It should also be noted the existing myth of the extreme importance of small and medium-sized enterprises in the innovative development of the economy. In fact, this is not true, the key innovative role in the modern world is played by large enterprises and organizations, and the importance of small and medium-sized businesses is constantly falling. Innovation activity is growing with the growth of the company. Small and medium-sized enterprises are mostly engaged in non-innovative forms of management, for example, wholesale and retail trade, public catering, domestic services, construction.

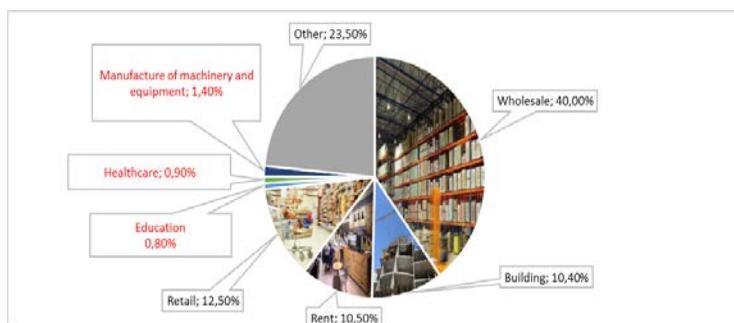


Figure 2 – Small and medium business by industry  
*Source: compiled by the author based on Rosstat data.*

Figure 2 shows the separation of small and medium-sized enterprises by industry for 2017. Figure 2 shows that the share of innovative industries is only 3.1% of the total share of all enterprises. Their combination is not capable of seriously affecting the development of an innovative economy. A very small part of small and medium-sized businesses is engaged in innovative entrepreneurship, and the emergence of new retail stores, coffee houses, and restaurants will not help accelerate the transition to an innovative economy.

**Discussion and conclusions.** Based on the analysis, the main directions are formed that will help accelerate the innovative development of the Russian Federation, which is especially important in the current conditions.

Thus, it is necessary to objectively understand the existing problems in the field of expenditures on an innovative economy and to follow the goal of increasing the efficiency of budget policy, including focusing on the directions proposed in this work. Improving the efficiency of expenditures on an innovative economy can stimulate progress in all sectors of activity and, as a result, accelerate economic growth!

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**Аннотация.** Основными задачами исследования являются анализ инновационной среды в России и представление путей развития в целях ускорения экономического роста за счет стимулирования инновационной деятельности. В работе анализируются существующие проблемы понижения инновационной активности, а также недостаточной эффективности проведения стимулирующей политики государства в инновационной сфере. На основе идентификации этих проблем предложены направления развития и целевые индикаторы, стремление к которым позволит преодолеть существующие трудности. Объектом исследования является влияние инструментов фискальной политики на инновационное развитие российской экономики. Предметом исследования является использование инструментов бюджетной политики для стимулирования инновационной активности российской экономики.

**Ключевые слова:** инновации, Инновационная политика, Стимулирование инноваций, Инновационная деятельность, Фискальная политика

**Annotation.** The main objectives of the study are the analysis of the innovation environment in Russia and the presentation of development paths in order to accelerate economic growth by stimulating innovation. The

paper analyzes the existing problems of reducing innovative activity, as well as the lack of effectiveness of the state's stimulating policy in the innovation sphere. Based on the identification of these problems, development directions and target indicators are proposed, the pursuit of which will help overcome existing difficulties. The object of the study is the influence of fiscal policy instruments on the innovative development of the Russian economy. The subject of the study is the use of budget policy tools to stimulate the innovation activity of the Russian economy.

**Keywords:** Innovation, Innovation policy, Promotion of innovations, Innovation, Fiscal policy

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### ACTUAL PROBLEMS OF ECONOMICS

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In the modern global economy, the strong position of a country or group of countries in commodity markets or individual markets for finished products, including engineering, Metalworking or aerospace technology, does not give automatic control over the global financial markets, and these markets in recent years have formed the investment climate in most countries, largely determining the nature of the country's development. Under these circumstances, it is necessary to once again carefully analyze the structure of Russia's economic potential and the possibilities of its market implementation in modern conditions, and that is why I consider this topic to be relevant today. Also, the relevance of the chosen topic is that the integration of a kind of emerging market Russian economy, along with the economies of Brazil, China and India (BRIC), into the world market in the coming decades is the most important issue of the future nature of world development.

Despite some successes of the Russian economy in the new century, it has a number of problems.

The most urgent problem for the Russian economy today is the high rate of inflation growth. Average annual growth rate

The main reasons for inflation in Russia are the monopoly of the Russian economy, the increase in world prices for goods, as well as an increase in budget expenditures, experts believe [1, p.32].

Frankly depressing were the figures for inflation in Russia - instead of the promised slowdown in consumer price growth, Rosstat reported an acceleration in inflation from 6.4% in 2013 up to 6.7% in January 2014. Yes, this is less than the 7.1% that occurred in the first month of 2013. However, the surge in inflation in early 2013. This was due to the statistical effect of a low base in the first quarter of 2012 due to political necessity, on the eve of the presidential elections, the Government has frozen tariffs for natural monopolies and housing and utilities, as well as gasoline prices. For this reason, the consumer price index grew by 4.2-4.5%. Enjoy a 6.7% price increase in January 2014 there are fewer reasons - by the end of the year, at this rate, inflation will accelerate to 7.5-8%.

First, this will be facilitated by a fan increase in the cost of imported goods and services due to the devaluation of the ruble.

Secondly, there will be an increase in the price of products that are formally domestic production, collected at "screwdrivers" - they consist of components, aggregates, semi-finished products of foreign production, which will automatically increase in price due to the fall in the ruble exchange rate.

Thirdly, because of the high degree of monopolized wholesale and retail trade, and the arbitrary price of dealers with a high likelihood of abuse of a monopoly position – trading networks will try to cash in on the devaluation and as it was in 2008-2009, under the slogan of the fall of the ruble and the increase in purchase prices, will inflate the prices of traded goods, regardless of the place of production.

Fourth, the statistical effect of the high comparison base in the second half of 2013 will be exhausted, when price growth shrank to 5.5-6% from 7-7.2% at the beginning of the year.

Thus almost all factors play not only against the ruble, but also against the contents of the pockets of ordinary Russians – has placed the economy on hydrocarbon raw needle, needle imported goods and services, and needle foreign loans, the government did not bother to stop the destruction of domestic high-tech industries and to revive domestic production of investment goods and consumer goods.

The structure of price growth raises the most questions. The growth rate of commodity prices decreased slightly from 6.9% in January 2013. up to 5.4% in the first month of 2014, for food – from 8.6 to 6.5%, for non-food products - from 5.1 to 4.3%. However, it is not clear why services continue to become more expensive at an accelerated pace – by 7.8% as in January 2014, as in the same period in 2013.

And this is despite the fact that the Government has formally frozen the tariffs of regulated industries for industrial enterprises with a broad gesture and limited their growth rates for the population to the General rate of growth in consumer prices. In fact, we see the unwinding of the flywheel

of inflation, which allows us to safely say that the forecast of the Ministry of economy for inflation in 2014. in the amount of 4.5% will be successfully failed. Even revised upwards the forecast of officials, in the amount of 4.8% seems unattainable manilovism and a good slogan that allows you to understate the extent of indexation of pensions and salaries to state employees, and spending on science, education, Economics, housing, etc.

Worse, the Central Bank of Russia's thoughtless transition to a policy of targeting inflation in the context of compression of the current account surplus (in 2012-2013, the surplus fell by 2 times – from \$72 to \$33 billion, which was the worst value since 2002), and the intensification of capital flight (about \$63 billion in 2013. and over \$17 billion. in January 2014 alone), the crisis recession in the economy (GDP growth fell by 2.5 times – from 3.4% in 2012. up to 1.3% in 2014), the destroyed domestic manufacturing industry of high processing (not only that the decline is recorded, but also output volumes are 2-5 times lower than in 1991) and critical dependence on imports (in General, by 50%, while for medicines by 80%, and for electronics and household appliances by almost 90%) will only provoke a depreciation of the ruble and, as a result, an increase in prices for imported goods, and with them a surge in inflation.

Due to the low degree of saturation of the economy with money (monetization less than 43%, which is 2 times lower than in Soviet times and in the countries of the European periphery and 2.5-3 times lower than in economically developed countries) fight non-monetary inflation by the Central Bank of the Russian Federation monetary methods (through increasing interest rates, reducing the volume of short-term refinancing of banks and curbing the growth of the monetary base and the money supply) will only exacerbate the shortage of money would cause a rise in price of credit resources and will exacerbate the investment crisis and the economic downturn. Thus, the Central Bank of Russia will only put the last nail in the coffin of the domestic raw material economy of one-and-a-half conversions [2].

In 2008, Russia became the first country among the world's economic leaders in terms of business corruption. This conclusion is made by the authors of the report of the largest international anti-corruption organization Transparency International.

If we talk about specific figures today, no one can tell you the exact data of annual corruption schemes and what is in the shadows. However, even if you take the most approximate data, the value turns out to be truly global and very eloquently answers the question why Russia, with its gas, oil, forest and other natural resources, continues to be inexcusably poor and backward. So, if we take a very average figure, we get about three hundred billion dollars. In other words, more than two thousand dollars were stolen

from every citizen, even a newborn or a pensioner. And it's not just salaries, pensions or scholarships. These are roads, medicines in hospitals, rotten pipes that make us sit without water.

The other question is, why, despite evidence of a global problem of corruption, which stands at the head of the pyramid titled actual problems of modern economy, the government, in the broad sense of the word, is fighting with her so sluggish that the result is not visible even under close examination, even if you really want to see at least some hope that the current situation will sooner or later change.

With the relative cheapness of labor in Russia, the skill level of employees and their labor discipline is estimated by most foreign and domestic experts as average. The mobility of domestic labor resources is low. Part of the economically active population is unable to find a job or change it due to the lack of funds to move to other areas, purchase housing there, and the difficulty of obtaining a residence permit. This limits the flow of labor to regions and industries that need it.

At present, the materialized part of the domestic capital – fixed assets – is noticeably worn out, insufficiently efficient and productive, and in most cases does not make it possible to produce competitive finished products. For example, the depreciation of fixed assets in the manufacturing industry is 47.8%, and the coefficient of their renewal is only 2.6%. According to the world economic forum estimates, Russia is in the last places in the rankings in terms of the level of development of technological resources as a set of applied technologies [3].

A huge amount of investment is required to update outdated fixed capital. A significant part of them can be mobilized within the country. But in our country, a significant part of gross savings goes abroad, including to pay off foreign debt, and settles in the state's gold and foreign exchange reserves. One of the main reasons for capital flight is the insufficiently favorable investment climate. This is confirmed by foreign investors. They also note that investments in Russian projects are associated with higher costs and risks than in other markets, which arise due to the presence of bureaucratic barriers, contradictory legislation and corruption [4].

Small business is an important link in the market economy. Today, Russia has an active policy of stimulating the development of small businesses, but we still have a lot of problems in this area. According to official statistics, the total number of employed in small businesses in Russia is almost 12 million people - only 18.3% of the economically active population, which is 2-3 times lower than the level of Western European countries. A distinctive feature of small Russian business continues to be a high share of the "shadow" sector - according to expert estimates, from 30 to 50% of the real turnover of small businesses.

Another problem in the economy is the development of such an important sector as agriculture. As a result of the transition to a market economy macro-economic changes (high inflation, falling of solvent demand for the products of agriculture, especially for livestock products, the decline in the share of spending on agriculture in the state budget, the restructuring of the national economy during the liberalization of the economy, caused the price disparity, the decline in investment activity) had a negative impact on the financial system of agriculture of Russia. Although the volume of agricultural production of all producers (agricultural organizations, farmers, farmers, population) in January-March 2014. in current prices, according to preliminary estimates, it increased by 4% compared to the indicator for the same period in 2013. and amounted to 350.1 billion rubles, and in March this figure was 151.7 billion rubles (+4.9%). This is not enough for the confident and successful development of agriculture.

Russia is still characterized by a huge role of the state in market relations and state regulation. In 2013, the share of the public sector in GDP was about 47-50%. The largest state-owned companies can be divided into several groups of enterprises that have monopoly control over certain activities. Various infrastructures, production and export of raw materials and resources, financial and information complexes are almost completely controlled by state-owned monopoly enterprises, such as Rosneft, Russian Railways, Gazprom and others.

Thus, in recent years, in parallel with the creation of the so-called sovereign democracy in Russia, the state sector is being created in the economy, which occupies a special, one might say, sovereign position. It allows you to control the development of the Russian economy as a whole due to the "practical monopoly of foreign economic activity and the occupation of command heights in the economy", manage financial flows, redistributing the profits of organizations and enterprises. share of small businesses in Russia. Today, large corporations have spread their influence almost everywhere and there are almost no free "niches" for small businesses. Accordingly, it is necessary to reduce the share of the public sector in the economy. For comparison, in the United States, the share of the public sector is about 14%, and in Russia about 50% [5].

Thus, Russia is an open economy and at the same time poorly integrated into the world market. The reorientation of Russia's trade occurred more geographically than structurally. Russian exports are still dominated by energy resources, which makes the Russian economy dependent on world prices for these goods. Favorable conditions on world markets create conditions for economic growth in the short term, but this is clearly not enough in the long term. The economy you must have a fully functioning market institutions. This makes it possible to develop industries

with high added value, ensure long-term economic growth, attract investment, and develop trade.

Under the current model of economic development, not only does Russia remain highly vulnerable to changes in energy prices, but it is also likely to limit economic growth below its potential. Countries with a high dependence on raw materials (which is characterized by a high share of commodity exports in GDP or in total exports) tend to perform relatively poorly in terms of economic growth, stability, corruption, human capital development, and other indicators.

Therefore, it is obvious that the priority goal of economic policy is to stimulate diversification, develop competitive industries that are not related to the commodity sectors, and encourage an "innovative" economy.

This strategy, according to leading economists, should include government interventions to stimulate certain sectors of the economy or certain geographical territories, including special economic zones, science and technology parks, state venture funds, the state development Bank, tax incentives, training programs, export incentives, and direct government participation in certain sectors of the economy. It is necessary to shift the focus from the classical liberal economic task aimed at creating equal conditions for private initiatives and entrepreneurship, to the "industrial" or "regional" policy, whose task, on the contrary, is to create special conditions for the priority development of certain sectors, regions or enterprises. Market forces are pushing Russia into a path of dependence on raw materials industries, and reducing its competitiveness in international markets, and that government intervention is required to solve this problem.

We can conclude that the current economic course of the Russian Government and its foreign policy strategy are contradictory. Today's vision of Russia's "national economic model" may be compatible with a strategy for developing an economy focused on raw materials, but such a model is unlikely to provide significant success in developing a highly competitive or innovative economy in Russia.

The analysis of the entire complex of internal and external economic conditions and prospects for Russia's participation in the international division of labor shows that today it is not changing the traditional fuel and raw materials specialization and forming a new, knowledge-intensive specialization that is becoming fundamentally important for our country. It is important to consistently diversify exports, preserving what has been achieved, but at the same time helping to overcome excessive dependence on exports of a narrow group of raw materials and materials and, in General, to increase the stability and predictability of foreign economic activity [6, p.3].

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**Аннотация.** В современной глобальной экономике сильные позиции какой-либо страны или группы стран на товарно- сырьевых рынках, или отдельных рынках готовой продукции, в том числе машиностроения, металлообработки или авиационно-космической техники, не дает автоматического контроля над мировыми финансовыми рынками, а именно эти рынки в последние годы формировали инвестиционный климат в большинстве стран, предопределяя во многом характер развития страны. При таких обстоятельствах необходимо еще раз внимательно проанализировать структуру экономического потенциала России и возможности его рыночной реализации в современных условиях, и именно поэтому я считаю эту тему актуальной на сегодняшний день.

**Ключевые слова:** экономика, анализ, актуальные проблемы, автоматический контроль, развитие страны.

**Annotation.** In the modern global economy, the strong position of a country or group of countries in commodity markets or individual markets for finished products, including engineering, Metalworking or aerospace technology, does not give automatic control over the global financial markets, and these markets in recent years have formed the investment climate in most countries, largely determining the nature of the country's development. Under these circumstances, it is necessary to once again carefully analyze the structure of Russia's economic potential and the possibilities of its market implementation in modern conditions, and that is why I consider this topic relevant today.

**Keywords:** economy, analysis, current problems, automatic control, development of the country.

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**ANALYSIS OF THE DYNAMICS OF FEDERAL BUDGET  
REVENUES IN THE FORM OF CORPORATE INCOME TAX IN  
2014-2018**

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**Introduction.** The Russian Federation is the largest state, which has great potential for economic development. Despite this, the economic position of Russia, as well as the economic position of other countries, is affected by external and internal factors that have a significant impact on its state.

Every system, including the state, may have problems and errors that need to be addressed in order for system to develop and function successfully. For identifying such problems or prospects, it is necessary to study the figures and indicators that characterize the economic and financial situation of the country [5, 6].

The Federal budget needs revenue to meet its obligations and cover the associated expenses. Thus, the analysis showed that the corporate income tax takes a significant share in the Federal budget revenues (2014 – 6.62%, 2015 – 7.14%, 2016 – 7.09%, 2017 – 8.32%, 2018 – 8.35%), at the same

time, it has a positive growth trend. It should also be noted that the study of the income tax and the reasons for its changes allows you to look deeper at its essence as a source of funding for the Federal budget.

The author set a goal to examine the dynamics of Federal budget revenues in the form of corporate income tax (CIT) and identify its cause.

**Materials and methods.** The research used research papers on the value of the revenue component of corporate income tax [4] and the determination of the tax burden on the fuel and energy sector of the Russian economy [7].

The research is based on statistical data from the Federal state statistics service, the Federal tax service, and the statistical and analytical resource Trading Economics.

**Research result.** According to the Federal state statistics service, corporate income tax revenues (CITR) have more than doubled from 2014 to 2018: from 411.3 billion rubles in 2014 to 995.5 billion rubles in 2018.

According to the news on the electronic news site Budget.RU a number of factors influenced the dynamics of state tax revenues [1]. At the same time, in our opinion, we should pay greater attention to such a factor as the dynamics of the ruble exchange rate against the dollar.

List of indicators described the main financial position of Russian organizations for the period 2014-2018:

Revenue from sales, (indicator #1)

Expenses that reduce the amount of revenue from sales, (indicator #2)

The amount of calculated income tax, including to the Federal budget, (indicator #3)

The exchange rate of the USA dollar against the Russian ruble (the average value for the year), (indicator #4)

Sales revenue index (chain method) in %, (indicator #5)

Index of expenses that reduce the amount of revenue from sales in %, (indicator #6)

Sales profit index (chain method) in %, (indicator #7)

The ratio of indices of income and expenses from sales in % (indicator #8)

Profit from sales in billion rubles, (indicator #9)

The average interest rate, calculated in the Federal budget (without regard to their changes) in %, (indicator #10)

The average interest rate, calculated in the Federal budget in %, (indicator #11)

The amount of the calculated profit tax in the Federal budget (without raising interest rates) in billions, (indicator #12)

The amount of calculated profit tax to the Federal budget in billion rubles, (indicator #13)

In Russia, one of the most dominant and fundamental sectors of the economy is the oil industry. This industry is fundamental in terms of providing a large source of tax revenue for the country. In addition, this industry is directly linked to the external consumer market and is dependent on the exchange rate of the ruble on the world market. For this reason, the oil industry was taken to consider the significant impact of changes in the ruble exchange rate on the national economy.

Over the past five years, price trends in the global energy market have changed quite significantly. After the fall in oil prices in 2014 from an average of about \$ 100 per barrel, prices did not break through the upper barrier, which was set at \$ 60 per barrel, in the market until the end of 2017. Only in 2018, prices broke through this barrier and reached the peak value for 2018, equal to \$ 74.11 per barrel (figure 1).

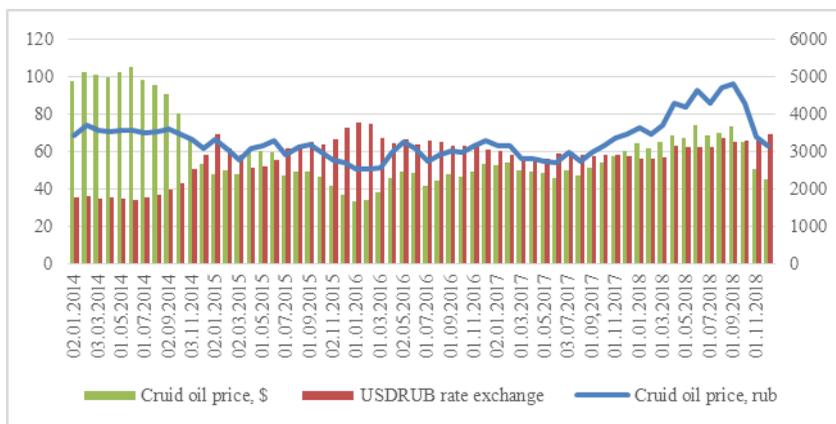


Figure 1 – Dynamics of oil prices in dollars, dynamics of the US dollar / ruble exchange rate, dynamics of oil prices in rubles

Source: compiled by the author of the paper; Source: Trading Economics

In ruble terms, the situation was slightly different. Just as in the previously provided data, oil prices could not overcome the upper barriers of oil prices, after their fall in 2014. The first barrier was set at 3 300 rubles per barrel. It was overcome, just as in the previous case, at the end of 2017. After that, in 2018, the level of oil prices increased and exceeded the values of 2014, after which it reached record values at the level of 4 826 rubles by September 2018 (figure 1).

**Discussion and conclusion.** After reviewing the initial data on the dynamics of Federal budget revenues in the form of corporate income tax: over the five-year period from 2014 to 2018, they increased by more than 2 times. What was the reason for such a strong growth in tax revenues in 2017-2018 and what is the reason for their overall dynamics?

In the article in the electronic resource Budget.RU is presented [1]. The reasons for changes in receipts to the consolidated budget of the Russian Federation for the first quarters of 2014 and 2015 are considered. In the electronic resource, the influence of these factors was checked over a time period of two years, but in order to identify a more accurate relationship, our own research was conducted over a time period from 2014 to 2018.

Let's look at how the dynamics of the ruble exchange rate affected Federal budget revenues. Let's pay attention to the dynamics of indicator #8: from 2014 to 2018, it took the following values in 1.02%, 1.02%, 0.98%, 0.99%, 1.02% by year, and indicator #4: the values of which also relate to a specific year of the five-year period from 2014 to 2018. 30.2 rubles, 33.5 rubles, 62.3 rubles, 76.4 rubles, 59.9 rubles, 57.6 rubles. The dynamics of revenue and expenses of organizations related to sales (indicators #1 and #2) have been growing throughout the period since 2014. So in 2014, they amounted to 179 498.2 and 170 053.2 billion rubles, and by 2018 they amounted to 257 580.0 and 239 426.1 billion rubles, respectively. Consider indicator #8 and indicator #4, noted earlier. It is noticeable that after 2016, the data have an inverse relationship, rather than a direct one, as in the period before 2016. Why is the connection more reverse than direct? Let's assume that initially, for many organizations, the devaluation of the ruble played the role of a weak or strong catalyst, which at first allowed them to get extra benefits and income from selling their products abroad. The growth in revenue caused by the high level of demand for relatively cheap Russian products allowed Russian organizations to successfully sell them, significantly covering the growing production costs caused by the fall in the ruble exchange rate. However, this favorable position of the conditions passed only as long as the supply of Russian products was not limited by different factors such as the introduction of sanctions on the import of certain types of Russian products and the subsequent decline in demand for these products. So, by 2016, the continued growth of the dollar against the ruble is no longer positive, but rather negative. The lack of sufficient demand for domestic products in foreign markets leads to a decrease in income, and the growth of production costs associated with the fall in the ruble continues, and only complicates the conduct of foreign economic activities. As a result, the profitability of foreign trade in Russian products is falling. This is largely due to the fact that the production costs of these organizations are based on raw materials or equipment imported from abroad [2].

When directly considering the dynamics of indicator 7 (has values in each year under review: 1.27%, 1.40%, 0.87%, 0.91%, 1.37%) and indicator #4 we can distinguish three life cycles of the Russian economy: the period of growth caused by the growth of profits together with the dollar exchange

rate from 2013 to 2015; from 2016 to 2017, there is a recession and recession; the growth of the Russian economy following the strengthening of the ruble. How these periods can be described. At the first stage, the Russian economy experienced a certain recovery, which could be caused, as previously mentioned, by the growth of the dollar and its temporary positive impact. At the second stage, the introduction of sanctions, which became more and more numerous every year, began to have an obvious negative impact on the foreign economic activities of many organizations, which led to a significant decline in the profit of organizations from sales in 2016. This trend continued until 2017.

The third stage requires special attention. And as the ruble exchange rate began to strengthen from the end of 2016 to 2018, the index of organizations' profit from sales began to acquire a direct dependence on the ruble exchange rate. By 2018, we see that the previously mentioned corporate profit index has increased significantly (indicator #7). The bilateral policy of the Russian President and Government played a particularly important role in this case. Its main aspects are aimed at developing domestic industry and ensuring its competitiveness for foreign producers, achieving import substitution of certain types of foreign products and, accordingly, reducing dependence on foreign markets for raw materials and equipment [3].

Why is it necessary to implement the appropriate policy? The consumption of products and the corresponding revenues received in the external consumer market have decreased, for the reasons mentioned above. There was a problem that the main economic burden is transferred to the branch of organizations that operate in a poorly developed domestic consumption market, which in turn are less developed than the branch of organizations that operate primarily in the foreign market. This transition of economic burden has led to a decrease in the total profit of organizations and, accordingly, tax revenues of the budget.

In their work, Lydia Bogdanivna this issue of dependence of Russian economy on foreign market of consumers and producers and of the dollar and confirmed the conclusion that the growth of the dollar, growing costs of domestic producers whose production is tied to foreign raw materials and products, as “a result of rising production costs resulted in rising prices for goods and respectively the inflation rate, which in result leads to decreasing purchasing power of the population” [4, c. 150].

Accordingly, the solution of this feature of the Russian economy, as its dependence on a foreign producer, should reduce the impact of currency exchange rate fluctuations on the national economy, in particular on the dynamics of prices on the domestic market [3]. The reduction in prices should contribute to the growth of organizations' profits and, consequently, the state's tax revenues.

Based on the calculation results for indicator 11 (which have values 1.99%, 1.99%, 1.99%, 2.99%, 2.99% accordingly, in each year of the five-year period from 2014 to 2018), it was found that the Federal budget revenue from corporate income tax increased due to the administrative intervention of the state. According to the data received, 3% of the corporate income tax rate is redistributed to the Federal budget from 2017, instead of 2%, as it was before.

We also note that by 2018, there is an increase in budget revenues, despite the fall in the dollar exchange rate. One of the reasons is the increase in oil prices (figure 1). So, if by 2017 oil prices had increased by only about 50% compared to 2016, then the increase in oil prices in 2018 reached peak values hovering around \$ 75 per barrel. This increase was enough to cover the previous fall in the dollar exchange rate and receive income from corporate income tax that exceeds the corresponding for the previous periods. "The rationale for this is that the main tax burden in Russia falls on companies directly related to the production and sale of oil" [7, p. 779], on the basis of which we assert that the Federal budget revenues are particularly strongly dependent on the oil industry, directly depends on all the previously listed factors of the dynamics of income from corporate income tax. Accordingly, following the increase in oil prices and the relatively high exchange rate of the ruble, which has a value of 57.6 rubles per dollar, the situation of the Russian oil industry has improved in the first place. Following this, the export of oil products in Russia increased, contributing to the growth of the country's international trade.

**Conclusions.** According to the results of the study, there is an increase in tax revenues of the Federal budget by 2018. It was caused by an increase in the profit of organizations, which occurred as a result of the appreciation of the dollar and an increase in the corresponding income of organizations from activities in the foreign market.

Let us answer that the author of the article [1] was right when he stated in his work that the increase in tax revenues from corporate income tax caused by the growth of the dollar against the ruble will be temporary and not so long-lasting. After this trend was identified, and the lack of further positive impact of the dollar exchange rate on the foreign economic activity of Russian organizations, the reverse stage has come, reducing the growth potential of the Russian economy.

A separate factor that caused the positive dynamics of corporate income tax is the increase in the rate of tax crediting to the Federal budget.

The role of the sanctions imposed on Russia during this period is also important. Of course, their presence has reduced the country's foreign economic activity in many sectors, and consequently had a very significant impact on Federal budget revenues.

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**Аннотация.** В данной работе поднимаются вопросы особенностей и условия формирования доходов федерального бюджета. Для успешного поиска ответов на возникшие вопросы, касательно причин динамики доходов федерального бюджета в виде налогов на прибыль организаций, нужно углубиться в изучение причин их возникновения. В этом и заключается актуальность данной работы. В данной статье рассматриваются проблемы динамики налогов на прибыль организаций, поступающих в федеральный бюджет. Целью исследования является выявление причин изменения динамики доходов федерального бюджета Российской Федерации на примере налога на прибыль организаций во временном промежутке пяти лет (с 2014 по 2018 года) с последующим их изучением и

описанием. По итогам исследования был выявлен перечень причин, которые вызвали определённые изменения в динамике поступления налога на прибыль организаций в федеральный бюджет, и дана их характеристика.

**Ключевые слова:** федеральный бюджет, доходы бюджета, налог на прибыль организаций, кризис, курс доллара к рублю.

**Annotation.** This paper raises questions about the specifics and conditions for generating Federal budget revenues. For successful search of answers to questions about the reasons for the dynamics of Federal budget revenues in the form of corporate income taxes, you need to delve into the history of their occurrence. That is why the relevance of this work is revealed. The problem considered in this paper is the dynamics of corporate income taxes received by the Federal budget. The purpose of the study is to identify the causes of changes in the dynamics of Federal budget revenues of the Russian Federation on the example of corporate income tax in the time period of five years (from 2014 to 2018 y.), followed by their study and description. According to the results of the study, a list of reasons that caused certain changes in the dynamics of corporate income tax revenues to the Federal budget was identified and their characteristics were given.

**Keywords:** Federal budget, budget revenues, corporate income tax, crisis, dollar-to-ruble exchange rate.

UDC 339.91

## **BUSINESS CULTURE FEATURES OF CHINA**

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**Introduction.** The relevance of our appeal to the topic of the features of Chinese business culture is determined by the interest in the rapid and successful economic development of China in the twenty-first century. China, with the largest population, is steadily implementing a policy of internal economic consolidation, which allows it to remain one of the world market leaders. China's economy is the second largest in the world by GDP at the moment, which indicates that China is a major player that cannot be ignored. Simultaneously with rapid economic development, China is famous for its rich history and business culture (the ability to communicate in business situations developed by generations of people, which is carried

by representatives of the business environment). It is worth noting that they mainly influence the formation of the mentality of Chinese citizens, which must be remembered, as in business and cultural communication [1].

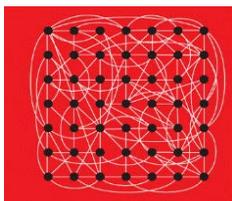
**Main part.** Now China is a huge production area, where there are the world's latest technologies and export-import channels are established and good business conditions are created. China is one of the most controversial countries in terms of doing business. It is necessary to understand that the Chinese are excellent sellers, and they can sell any product. But do not forget that "being dishonest" is an important feature of their business culture [4]. For successful business development, it is necessary to know and take into account the peculiarities of China's business culture. Let's look at these features in more detail.

1. The law in China always works against buyers from other countries. Chinese businessmen adhere only to the laws of China and do not take into account the laws of other countries (Ming-er Chen) [8].

China's bureaucracy is huge and coordination of various issues requires a lot of time and effort in the country. In addition, the Chinese are very scrupulous people who do not make decisions without thoroughly studying all aspects of the case. Therefore, the negotiations should involve highly qualified specialists who understand all the subtleties of the issue and a good translator who knows specific terms [6].

3. The influence of Confucianism on China is clearly visible in the business culture of China. So, in this country, there is still a strict vertical integration, or in other words, a hierarchy. In business communication with the Chinese, you should always keep in mind the hierarchical chain. The decision of the person above you cannot be challenged [8].

4. Communications in China are a social credit that indicates a person's personal status (Ming-er Chen) [8]. To denote such social connections and acquaintances, the special concept of Guanxi is used. In China, "It doesn't matter what you know, it matters who you know" is paramount to doing business. The Chinese term "Guanxi" is used to refer to the concepts of "connection" and "relationship". Guanxi is a business tool and a great way to get access to all kinds of resources, ensure their integrity and safety. For Chinese business, Guan – is the basis of business ethics, while for Russian business it is just a tool for achieving goals (Fig. 1).



## Figure 1– Guanxi in China [8].

One explanation for the Guanxi system is in Confucianism, which exists in China more than 2,500 years. This philosophy holds that the right relationships creation is the key to social harmony. According to Confucianism, there are five main types of relationships: boss and subordinate; father and son; husband and wife; older brother and younger brother; friend and friend.

5. In business culture, the role of superiors and subordinates is blurred, because even a manager can do the same job as other employees for the common benefit. But there is still a Chinese-type model, and it is quite narrow. In Chinese companies, there are many positions, but only some units have the real right to make decisions and, moreover, can take responsibility [6].

6. An important rule of etiquette in China is also considered to show respect for the culture and values of the country. Knowledge of history and traditions is one of the keys to successful negotiations.

7. Business negotiations in China begin after the contract is signed. Chinese business considers the contract "as a document that is accepted by the parties to avoid unnecessary disputes, and can always be changed, supplemented or torn up depending on changed circumstances." This is especially true for small Chinese enterprises operating outside of developed megacities. Entrepreneurs who want to establish cooperation with the Chinese side need to be prepared for the fact that for a Chinese signature on the contract makes the document not binding, but a necessary paper for submission to arbitration. For Chinese and especially those living in the Northern provinces of the Republic, personal oral agreements traditionally have more weight than papers (V.A. Pushnykh) [6].

8. The concept of "face" and its preservation in the business culture of China is another crucial key, both in business and in everyday communication with the Chinese. In Chinese culture, "face" is the society's assessment of how well a person meets social norms, and their trustworthiness in relation to society. It is unacceptable to make comments to a Chinese in the presence of other people and especially his/her subordinates. It is unacceptable to try to force them to admit their mistakes. Even if the relationship has reached a critical point, the conversation must take place one-on-one. This will show respect, and the partner will save "face" (Ming-er Chen) [8].

9. O.R. Ochirov believes that it is impossible to refuse offers which do not suit them. It is better to use the phrases "we will think about what can be done", "we should think about it", "we will consider your suggestions", etc. Such language, which usually hides a refusal, is used by the Chinese themselves. To appeal to different cultures and national peculiarities of

doing business is fraught with insult. The phrases "we do not do this", "you do not understand how such issues are resolved in our country", etc. can be perceived as a reproach for incompetence and unprofessionalism [5].

10. In the business culture of China, an interpreter is required during negotiations, as China has a low level of English language proficiency.

11. Familiarity is a very important stage in establishing a business partnership in China. When meeting a business card must be submitted in a special way: two hands with a bow, and when shaking hands, you should look down, which indicates that the person in front of you is higher in rank. After accepting a business card from a partner, it is important to read it and put it in a special business card holder instead of in your pocket, thus showing respect for the person [3].

12. In China, the cult of gifts has developed in business communication, which are not only a pleasant addition to negotiations, but also a powerful business tool. Gifts, of course, should also be given in accordance with the strict hierarchical structure of China. You can't give the same gifts to people at different levels of the chain of hierarchy. When choosing a gift, you should remember some features: the white color represents death in China, cutting objects – the break of any relationship, the number 4-misfortune [3].

13. "Food bribes" is a feature of China's business culture. In China, the cults of food and business representatives are no exception in this regard. Lunches and dinners with partners and clients are an invariable part of business etiquette and a place for negotiations. Business meals in China, or rather the cost and variety of the menu, become an opportunity to demonstrate the well-being of the host party, as well as an opportunity to "force" foreigners to make concessions or preferences [3].

14. In the course of business communications, we should not forget about the features of non-verbal behavior, believes A.A. Maslov. China is a country of low body contact, so when communicating, you should avoid any touching, even a strong handshake is regarded as a sign of excessive aggression and disrespect for the interlocutor. Direct eye contact should also be avoided – this is a sign of bad manners [3].

15. The feature of Chinese colloquial speech is noise. It may seem that the partners are quarreling or swearing, but loud speech is the accepted norm in the country.

16. The Chinese often show indifference to the matter under discussion.

17. The Chinese in business communication can show anger or even aggression.

18. A. Devyatov believes that the business culture of China is characterized by a large amount of flattery, insincere, sometimes too rude [2].

19. Chinese people can also ask business partners for quite personal things: about family, parents, home, etc. However, it is worth remembering that China is a traditional country and the topics of death, sex, and divorce cannot be discussed [1].

20. Ming-ger Chen points out that small mistakes in China's business culture are excusable, while large ones are punishable. If a small mistake occurs, one will be forgiven for it, for example, if you nod your head (in Chinese culture, this is not accepted) [8].

21. Lack of punctuality. The Chinese often use the words "somewhere like this", "mostly at this time", and so on to denote punctuality [6].

We will conduct a comparative analysis of the business culture of China and Russia by measuring the culture of G. Hofstede [9] (table 1).

The following conclusion can be drawn that according to the theory of G. Hofstede [7], the common features of Chinese and Russian business cultures are: strict adherence to hierarchy, centralization of power and clear subordination of employees in the organization; a high level of collectivism (in China, the tendency to collectivism is expressed more strongly), a tendency to group responsibility; lack of attention to free time and their desires, a large pressure of social and social norms. Significant differences are observed in the dimensions: masculinity – femininity, avoidance of uncertainty.

Table 1 – Comparative analysis of the business culture of China and Russia according to the theory of G. Hofstede [9]

Component of model	Business culture of China	Business culture of Russia
Distance of power	A high level, since people in society and organizations are not equal. The relationship between the subordinate and the boss tends to be polarizing, and there is no protection against abuse of power by the authorities.	This is a very high level, because those who have power are very far from the people due to their centralisation (all business is concentrated in Moscow) and status.
Individualism / collectivism	A high level of collectivism, since the family is the cornerstone of Chinese society. Workers in China tend to prioritize group-based by considering collective interests above their own. Loyalty friend to each other is of paramount importance, because in the organization everyone takes	Average level of collectivism. In Russia there is a centuries-old tradition of collectivism and paternalism. Individualistic qualities and behaviors have traditionally been classified as undesirable and therefore repressed. Russian entrepreneurs still have a strong sense of internal camaraderie, and Russian organizational members distinguish three different forms of

	responsibility for other members of your group. The scale of "individualism" is low, because China is a culture where people act in the interests of the group, not by themselves.	group: symbolic collectivity of the enterprise as a whole; collective identification of ordinary employees; and collectivity of direct working group
Masculinity / femininity	China is a " male " society – focused on success. Many Chinese sacrifice priorities such as family and leisure. Employees, for example, will provide services until very late in the evening.	Low level of masculinity, as Russian entrepreneurs are used to underestimate their personal achievements and deposits and also usually speak very modestly about themselves. Dominant behavior can be accepted when it comes from the manager, but is not valued among the colleagues and employees.
Avoiding uncertainty	Has a low level, but compliance with laws and regulations it can be flexible considering the real situation, and pragmatism is a fact of life. The Chinese feel comfortable in an ambiguous situation.	A very high level, because the Russians are very hampered by ambiguous situations, and they have created one of the most complex bureaucracies in the world. When negotiations are underway, the main attention is paid to creating relationships and therefore preparing for them. All steps are discussed in great detail and in advance. Russians prefer to have contextual and reference information
Long-term orientation	It has a very high level, as the Chinese business culture is very pragmatic. The Chinese believe that the truth depends largely on the situation, context, and time. They demonstrate the ability to easily adapt traditions to changed conditions, a strong propensity to save and invest, thrift and perseverance in achieving results.	A very high level, since Russia is definitely a country with a pragmatic mindset. Russians believe that the truth in many ways depends on the situation, context, and time; it is easy to adapt traditions to changed conditions.
Indulgence / restraint	It has a low level, since China is a reserved society, it tends to be cynical and pessimistic, and it has the idea that the actions of any person are restrained by social norms.	It has a very low level, since Russia is a reserved society, it tends to be cynical and pessimistic, and it has the idea that the actions of any person are restrained by social norms.

We will conduct a comparative analysis of the business culture of China and Russia according to the theory of R. Lewis [3] on the measurement of cultures on intercultural interaction (table 2).

It should be noted in the conclusion that China can be classified as a reactive type of business culture according to R. Lewis [3], who notes that the Chinese are introverted and prefer to listen, and only then do.

We will conduct a comparative analysis of the business culture of China and Russia according to the theory of F. Trompenaars [7] on measuring people's preferences and values in different cultures of the world (table 3).

It can be concluded that the Chinese and Russian business cultures have many intersections according to F Trompenaars's model [7]: particularism, origin, diffusivity, external control. The only difference is the attitude and expression of emotions.

Table 2 – Comparative analysis of the business culture of China and Russia according to the theory of R. Lewis [3].

Component of model	Business culture of China	Business culture of Russia
Monoactivity	Low level of task orientation. They do not clearly plan their activities.	Average level of task orientation, clearly plan their activities.
Polyactivity	The Chinese are not focused on people, talkative and a little outgoing.	Russians are focused on people who are verbose and sociable.
Reactivity	Chinese are introverted. They are very sociable. They appreciate mutual respect	Russians are extroverts, they are open to the outside world and others, they are very sociable and energetic, as well as very friendly with people and confident

Table 3 – Comparative analysis of the business culture of China and Russia according to the theory of F. Trompenaars [7]

Component of model	Business culture of China	Business culture of Russia
Universalism-particularism	China's particular orientation is based on the social credit of Guanxi	Russia is a country of particularism and business relations should focus not on contracts, acts and laws, but on personal relationships with partners.
Emotionality-neutrality	In China, it is important to control emotions in the business world interaction. Decisions are made under the influence of reason, not feelings, and emotions are not displayed. People in Chinese culture: a) strictly manage their emotions; b) do not allow feelings to interfere with professional relationships; c) observe and interpret other people's emotional reactions.	Russian culture belongs to emotional types, as Russians are very sociable, like to gather in groups and discuss not only work, but also personal problems. They are very democratic in the process of communication, they can ask any questions they are interested in, ask the other person for advice or give advice themselves, whether you want it or not.
Individualism-collectivism	A high level of collectivism, since interaction in the group and collective responsibility.	A high level of collectivism, since interaction in the group and collective responsibility

Achievement-origin	High level of origin, since China values who you are, rights and powers matter most, so they tend to often use powers and show respect for people with official authority.	Since Russia is located at the intersection of Western and Eastern cultures, it occupies an intermediate position in this parameter, but with a tendency to origin.
Specificity-diffuseness	High level of diffusivity. Representatives of this type cultures consider various aspects of their lives holistically. Here people's personal and professional lives intersect. There is no clear distinction between workplace relationships and other types of social relationships.	High level of diffusivity. Representatives of this type cultures consider various aspects of their lives holistically. Here people's personal and professional lives intersect. There is no clear distinction between workplace relationships and other types of social relationships.
Time perspective	Polychronic.	Polychronic.
External-internal control	A high level of external control, since everything goes its own way and a person does not have the ability to influence events and control the results. Entrepreneurs rarely Express open dissatisfaction with the decisions of their superiors, preferring to adapt to existing circumstances.	A high level of external control, since everything goes its own way and a person does not have the ability to influence events and control the results. Entrepreneurs rarely express open dissatisfaction with the decisions of their superiors, preferring to adapt to existing circumstances.

**Conclusion.** Thus, the business culture of China undoubtedly has its own characteristics. When organizing Russian-Chinese cooperation, it is necessary to take into account various factors: masculinity – femininity, avoiding uncertainty. Differences in the first of these dimensions lead to difficulties in building Sino-Russian relations. For example, representatives of Russian enterprises are focused on establishing not only working, but also personal relationships, which may be perceived by Chinese partners as a violation of personal space.

The focus of Chinese companies on success, competition and competition can create an uncomfortable working situation for Russian representatives. When organizing Russian-Chinese cooperation, Russian entrepreneurs first need to disclose and explain the case in detail, and only then proceed to the conclusion of the contract. When doing business with the Chinese, it is necessary to avoid emotionality, since Chinese entrepreneurs will be reluctant to work and maintain an entrepreneurial relationship with someone who cannot control their emotions.

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**Аннотация.** Благодаря росту экономики Китая жители этой страны стараются адаптироваться к общепринятым правилам предпринимательства, европейским нормам этикета. Тем не менее, у китайцев до сих пор сохраняются и широко используются свои особенности в этих вопросах, берущие начало в истоках азиатской культуры. В статье рассмотрены особенности деловой культуры Китая. Проведен сравнительный анализ деловой культуры Китая и России по культурологическим моделям Г. Хофстеде, Р. Льюиса, Ф. Тромпенаарса. Даны рекомендации по работе с китайцами предпринимателями для российских предпринимателей.

**Ключевые слова:** Китай, деловая культура, измерения культуры, Г. Хофстеде, Ф. Тромпенаарс, Р. Льюис, гуаньси, конфуцианство.

**Annotation.** Due to the growth of the Chinese economy, residents of this country are trying to adapt to the generally accepted rules of business and European standards of etiquette. However, the Chinese still retain and widely use their own characteristics in these matters, which originate in the origins of Asian culture. The article considers the features of China's business culture. A comparative analysis of the business culture of China and Russia based on the cultural models of G. Hofstede, R. Lewis, and F. Trompenaars. Recommendations on working with Chinese entrepreneurs for Russian entrepreneurs are given.

**Keywords:** China, business culture, dimensions of culture, G. Hofstede, F. Trompenaars, R. Lewis, Guanxi, Confucianism.

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**DOES THE GOVERNMENT NEED TO REFUSE TO PROVIDE  
GUARANTEE EARLY ASSIGNMENT OF PENSIONS TO CERTAIN  
CATEGORIES OF CITIZENS?**

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**Introduction.** Russian studies in the analysis of the pension system reveal its characteristic shortcomings. In the works, it is often noted the need for its reform [1, 3]. According to the author, first of all, it is necessary to pay attention to the system of early retirement benefits, since under this inertial scenario (the option of continuing the trends), it is impossible to achieve an acceptable level of retirement benefits, as well as ensuring a balanced and long-term financial stability of the pension system of the Russian Federation.

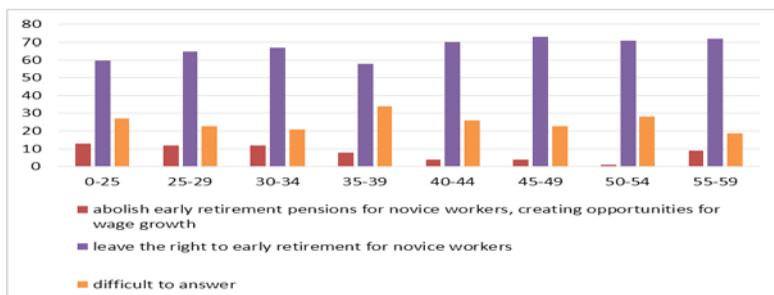
In accordance with the “Strategy for the Long-Term Development of the Pension System of the Russian Federation until 2030”, the main principle of the institution of early retirement pensions is to maintain a system of social guarantees for workers employed in industries with special working conditions, to maintain citizens' trust in the law and actions of the state, and inadmissibility of arbitrary changes in the legislation of the Russian Federation, as well as the establishment of a transition period in order to adapt citizens to new conditions of pension provision. However, these "new conditions" again aggravated the question of the appropriateness of using this institution.

The text of the Strategy directly indicates that early pensions created during the period of the existence of the USSR do not meet modern market conditions and, in addition, are socially unfair. The developers are well aware that the widespread adoption of early pensions was associated with forced industrialization conducted by the USSR in 1930-1990. The institute of early retirement pensions was of a compensatory nature: a high proportion of people employed in harmful and dangerous working conditions did not have the opportunity to participate financially in voluntary types of pension and medical insurance, there were no mechanisms to prevent exposure to risk, as well as its accounting and

determination of the degree of disability, and there was no medical and social rehabilitation workers with early forms of occupational disease. But most importantly, in 1930 the institute of compulsory social insurance against industrial accidents and occupational diseases was rejected.

As Vladimir Roik notes, the widespread adoption of early pensions is due to the fact that the institution of early pensions was well integrated into the socialist system of labor reproduction. "Distorting the true value of labor, the state, in the framework of centralized price planning, underestimated the cost of production in the necessary sectors" [6, p. 27]. Unfortunately, modern regulation could not get away from the problems that were in the Soviet Union. The difficulty, perhaps, lies also in the fact that it is almost impossible to find an analogue to early retirement pensions in terms of funding and scale of coverage. According to the Independent Institute of Social Policy, early retirement pensions account for about a third of all pensions granted in the country. Despite this volume, the simplified mechanism for assigning early retirement benefits is far from the insurance principle, which leads to a significant distortion of the statistics on the depreciation of the workforce in jobs with a high level of professional risk. The general condition of the system is affected by the absence of indicators for determining disability, the actual age of early retirement and the length of periods for receiving pensions, the amount of accumulated funds in the individual accounts of insured persons and actually paid aggregate amounts of pensions, including appointed ahead of schedule. The absence of this accounting leads to the fact that early pensions cover only the potential risk of disability. This is precisely where social injustice is manifested: for one employee, an early pension will become compensation for actual disability, and for another it will be a pleasant addition to wages.

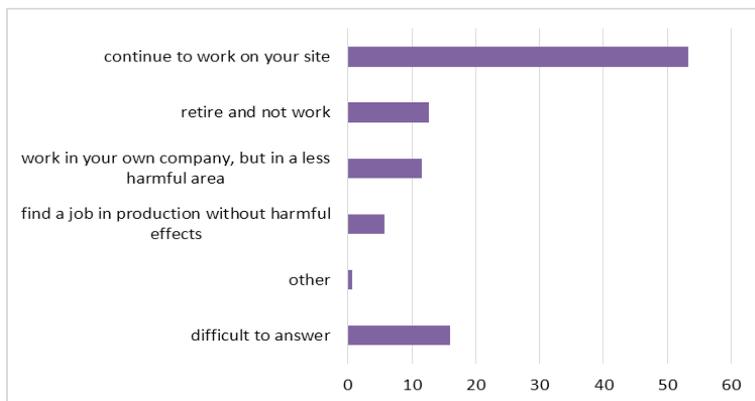
**Materials and methods.** For a comprehensive analysis of the possible consequences of pension reforms, of particular interest is the study conducted by the Institute of Social Analysis and Forecasting, RANEPА [2]. In the course of the study, a survey was conducted among employees on Lists No. 1 and No. 2 and managers of enterprises in the Republic of Bashkortostan. This report made possible to analyze the self-esteem of the health, work behavior and motivation of workers engaged in harmful and dangerous working conditions, to study the opinion on the prospects for further reform of the system of pre-term pensions (Picture 1).



Picture 1 – The opinion of employees for the abolition / preservation of early retirement pensions, %

Source: <https://www.ranepa.ru/social/news-social/doklad-eleny-grishinoy-o-dosrochnyh-pensiyah-na-vrednyh-proizvodstvah> [4]

Also, the results of the study show that 53.3% of respondents will continue to work in their place after the appointment of an early pension. The main motive is material interest (Picture. 2). The managers gave a higher estimate, suggesting that 80-95% of employees will remain at the enterprise after they have been given an early pension.



Picture 2 – Employee plans after early retirement, %

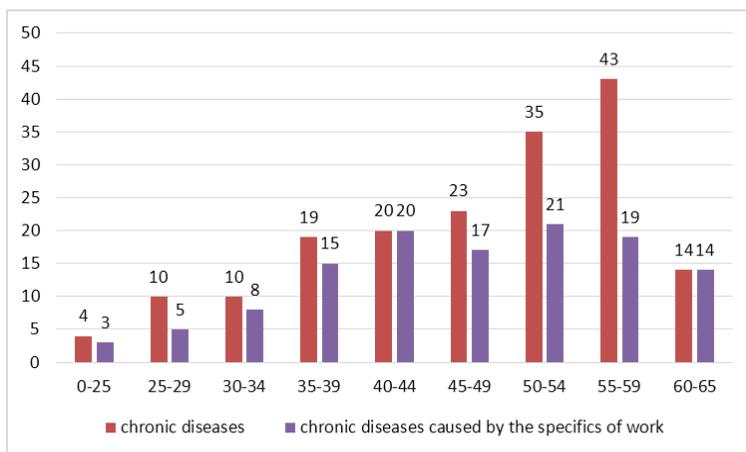
Source: <https://www.ranepa.ru/social/news-social/doklad-eleny-grishinoy-o-dosrochnyh-pensiyah-na-vrednyh-proizvodstvah> [4]

Statistics obtained as a result of a survey of different age groups makes it possible to approximately estimate the age of disability in work with harmful and difficult working conditions (Picture 3). So, there is a sharp deterioration in health by 55-59 years. Federal Law 400-FL, dated 28 Dec. 2013, «On Insurance Pensions» just presumes the retirement age for

categories of workers employed in harmful and difficult working conditions, in the range of 45-50 years for women and 50-55 years for men.

Thus, it is assumed that a change in the retirement age for these categories will not take into account the actual age of disability.

Moreover, the assessment of the health status of workers is quite different depending on the industry. Currently, according to Art. 213 of the Labor Code of the Russian Federation, an assessment of the health of workers engaged in heavy work and work with harmful and (or) dangerous working conditions (including underground work), as well as work related to traffic, can be carried out according to preliminary results and periodic medical examinations. The regulatory framework for these procedures is the order of the Ministry of Health and Social Development of the Russian Federation №83, dated 16 Aug. 2004, “On approval of the lists of harmful and / or hazardous production factors and work, during which preliminary and periodic medical examinations are carried out, and the procedure for conducting these examinations”.



Picture 3 – Estimated age of disability

Source: <https://www.ranepa.ru/social/news-social/doklad-eleny-grishinoy-odosrochnyh-pensiyah-na-vrednyh-proizvodstvah> [4]

However, it is worth noting that this act does not contain requirements for medical inspections. Thus, the health status of workers is determined as if a priori, only by the results of certification of jobs or a special assessment of working conditions.

**Results.** The analysis allows us to formulate recommendations for reforming the system of early retirement benefits. First of all, sociological studies show that the overwhelming majority of employees (67%) are in favor of preserving the right to early retirement pension, but this fact should

not impede the gradual transformation of this institution, which can happen as follows:

1. Despite a number of advantages of the special assessment of working conditions, which should include additional contributions to the Pension Fund of the Russian Federation for harmful and dangerous working conditions, the possibility of declaring jobs with acceptable and optimal working conditions every 5 years with further prolongation, the methodology of special Estimates in many respects loses to the certification of workplaces. The manual on hygienic assessment of the factors of the working environment and the labor process, on which certification of workplaces was based, made both quantitative and qualitative indicators, while the method of the same name, a special assessment of working conditions, assesses the artificially reduced range of quantitative factors. This position is contrary to the metrological support of the assessment of harmful production factors, which creates precedents for low objectivity of the results. It is important to note that a decrease in the number of factors assessed can reduce the cost of the assessment, however, a full assessment creates the need for production control, which leads to additional financial costs. In order to more fully cover the factors of the working environment and the labor process, it is proposed to harmonize the methods carried out within the framework of certification of workplaces and a special assessment of working conditions on the basis of labor medicine centers with the inclusion of an assessment of the quality indicators of a harmful production factor, which will allow a full assessment of a harmful production factor at every workplace.

2. It is necessary to strengthen control on the part of Rostrud over compliance with the requirements of Federal Law 426-FL «On Special Assessment of Working Conditions». As practice shows, as of 2019, not all employers have taken the necessary measures to obtain the results of a special assessment of working conditions. So, only in the Tula region 1316 jobs do not have an opinion on classes and subclasses according to working conditions [4]. This situation creates an additional burden on the budget of the Pension Fund of the Russian Federation, as employers who have not assessed continue to pay insurance premiums at lower rates of 4% and 6%, depending on the class of hazard.

3. To conduct an inventory of existing lists and lists of harmful and hard work, taking into account professional standards. The most frequently cited example as a demonstration of the mismatch between professional standards and Lists is the situation with the definition of the profession of electric gas welder. So, according to the professional standard, it is proposed to use the names “welder” or “electric welder”, however, in ETKS and “Lists” the name “electric welder” is used. Guided by the Lists, the Pension Fund of the Russian Federation has the right to refuse to grant an

early pension to a citizen. In order to avoid such conflict situations, it is recommended that the employer additionally draw up a protocol of the internal commission, which will fix the norms of legislation on the basis of which an adjustment was made to the job title, as well as a note on the symmetry of working conditions. However, such a procedure requires additional financial resources from the employer, and the exclusion of the “new” profession from the preferential one, on the contrary, removes the need for the employer to pay insurance premiums at an additional rate, even if working conditions are recognized as dangerous or harmful. This approach will eliminate the additional costs of the employer to assess the symmetry of working conditions, as well as simplify the procedure for obtaining an early retirement pension by an employee.

4. For workers in the field of education and health care, it is proposed that the system of early pensions be phased out and replaced with other social institutions. The latter include voluntary health insurance programs, voluntary pension insurance programs, and private pension schemes.

5. To analyze the legal regulation of the early appointment of old-age pensions for teachers with a scientific justification for the age of disability.

6. To consider the possibility of combining cash and information flows of the Federal Tax Service and the Pension Fund of the Russian Federation when administering insurance contributions for compulsory pension insurance [7].

7. One of the goals approved in the Strategy for the Long-Term Development of the Pension System of the Russian Federation is the development of a three-level pension system for groups with different incomes. This goal can be achieved by creating a system of social guarantees for employees regarding voluntary pension insurance or non-state pension coverage. At present, the general requirements for early non-state pension provision, enshrined in Federal Law 75-FL «On Private Pension Funds», do not create any motivation for the employer in the formation of corporate pension programs. Among the methods of stimulating the employer and employee to create and participate in the pension systems of early private pension provision, the following can be noted:

- exemption of employers who have created early private pension systems from paying insurance premiums at an additional rate, since there is a transition from the state system to the non-state;
- receipt by the employee of pensions from the Pension Fund of the Russian Federation and early private pension provision in proportion to the periods of payment of insurance premiums at additional rates and pension contributions in the framework of early non-state pension schemes;

- co-financing of the program by the state, subject to the participation of the employee;
- maintaining for the Pension Fund of the Russian Federation a fixed payment for early private pension [2].

**Discussion and Conclusions.** The introduction of such a system will shift the responsibility for early pension payments from the state to the employer as part of a social partnership, and this will also ensure transparency of the early pension system through personalized accounting. The development of such systems will give a new impetus to the development of corporate pension programs, increase the financial stability of private pension funds, and most importantly, will allow the formation of an additional investment resource.

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**Аннотация.** В работе рассматривается вопрос о досрочном назначении пенсий в Российской Федерации. Проведен анализ становления института досрочных пенсий и его эффективности. Дана оценка возможным последствиям отмены досрочных пенсий. Выявлены основные недостатки специальной оценки условий труда в сравнении с аттестацией рабочих мест. Сформирован ряд

рекомендаций по корректировке действующего института досрочных пенсий. На основе общемировых трендов предложена модель постепенного перехода на досрочное негосударственное пенсионное обеспечение.

**Ключевые слова:** пенсионная система, обязательное пенсионное страхование, страховые пенсии, досрочные пенсии, СОУТ.

**Annotation.** The article considers the issue of early assignment of pensions in the Russian Federation. The analysis of the formation of the institution of early retirement pensions and its effectiveness. The assessment of the possible consequences of the abolition of early pensions. The main shortcomings of a special assessment of working conditions in comparison with the certification of jobs have been identified. A number of recommendations have been made on adjusting the current institution of early retirement pensions. Based on global trends, a model is proposed for a gradual transition to early non-state pension provision.

**Keywords:** pension system, compulsory pension insurance, insurance pensions, early pensions, special assessment of working conditions.

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**DIFFICULTIES IN THE DEVELOPMENT OF COMMERCIAL ORGANIZATIONS UNDER THE CURRENT DEMOGRAPHIC SITUATION AND THE INCREASE IN RETIREMENT AGE**

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**Introduction.** The ageing of the population will very soon become one of the most pressing problems of all humanity. According to UN forecasts, by 2050 there will be 3.2 million people on Earth over 100 years old, for 2013 such people were slightly more than 300 thousand people [7]. The share of people over 60 years in 2013 was at 11.7%, and by 2100 this value will increase more than 2 times, up to 27.5%. The increase in the number of pensioners will lead to an increase in pension costs. Besides, the opposite tendency is also observed: decrease in number of able-bodied citizens. Thus, according to UN data, the old age dependency ratio (ratio of

population aged 65+ years per 100 economically active people) in the world will change from 14.3 in 2020 to 37.5 in 2100.

Looking at the world's macro regions, each has seen similar growth, with the ratio increasing two or three times over 80 years: in Africa from 6.3 to 21.6; in Asia from 13.1 to 47; in Europe from 29.5 to 58.6; in South America and the Caribbean from 13.4 to 56.2; in North America from 25.8 to 58.5; and in Oceania from 20.1 to 43.4.

It is important to note that in recent years issues related to the modernization of pensions have been raised in a number of scientific publications, including those related to the study of foreign characteristics (in the countries of the former USSR [1], China [5], Israel [4] and the European Union [2]). However, they have not considered demographic factors, which now play an important role in modernizing the pension system.

According to the UN, by 2050, the proportion of people over 65 years of age per 100 economically active people in Russia will approach 39.2%, that is, every third person will need a pension. Also, the analysis showed that by 2100 almost every second Russian will be a pensioner, which can not be ignored when making changes in the pension system.

In order to avoid the impact of demographic trends, countries are deciding to raise the retirement age. These decisions were made at different times, for example, in the United States in 1983, and in Europe the process began in the 2000s, the process of change itself is also different (the United States, Germany, Russia and others are smoothly raising the retirement age; France, Israel and other countries have decided on a rapid increase in the age by several years) and there is also a different reaction of society to such changes.

The aim of this work is to develop proposals to smooth the impact of demographic trends and increase the retirement age on the activities of commercial organizations.

**Materials and methods.** The method of studying and analyzing articles and regulations on demographic trends and increasing retirement age as well as the data of the Pension Fund of the Russian Federation were used to write this work.

**Results.** The Russian Federation also pays special attention to the complication of the demographic situation. Decree of the President of the Russian Federation of 31.12.2015 № 683 "On the National Security Strategy of the Russian Federation" reflects aspects that are the basis of strategic planning, which defines the national interests and strategic national priorities of the Russian Federation, goals, objectives and measures in the field of domestic and foreign policy aimed at strengthening the national

security of the Russian Federation and ensuring sustainable development of the country in the long term<sup>3</sup>.

In order to identify which issues needed to be addressed, several threats were highlighted, among which was the complication of the global demographic situation.

One of the solutions to this threat, which was outlined in the national security strategy of the Russian Federation, was Federal Law № 350-FZ of 3 October 2018 "On introducing amendments to certain legislative acts of the Russian Federation on the appointment and payment of pensions", which provides for raising the retirement age<sup>4</sup>. The changes are designed for 10 years: from 2019 to 2028. During this period, the retirement age will increase equally for women and men by 5 years, to 60 and 65 years respectively. (see Figure 1.) The first adjustment will concern those who should have retired between 2019 and 2020, i.e. in the absence of early retirement entitlement: women born 1964-1965 and men born 1959-1960.

However, according to the author, such a change should not be limited, as an increase in the retirement age will have a positive effect only in the short and medium term. At the same time, in the long term, in the absence of other measures, this decision will not play a significant role, including through changes in demographic indicators. This can be seen in the example of the Russian Federation. In order to estimate what kind of pension will be received by pensioners, as well as how much money is required for this, the author has made calculations for different variants of developments for the next 11 years: the first one - without any changes, the second one - taking into account changes in the pension age.

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<sup>3</sup> Decree of the President of the Russian Federation dated 31.12.2015 No. 683 "on the national security Strategy of the Russian Federation". – [Electronic resource]. – Access mode: [http://www.consultant.ru/document/cons\\_doc\\_LAW\\_191669/](http://www.consultant.ru/document/cons_doc_LAW_191669/)

<sup>4</sup> Federal law No. 350-FL, 03.10.2018 "On amendments to certain legislative acts of the Russian Federation on the appointment and payment of pensions". – [Electronic resource] – Access mode: <http://www.consultant.ru/cons/cgi/online.cgi?req=doc&base=LAW&n=308156&fld=134&dst=100000001.0&rnd=0.5972285956386296#02863371888380595>

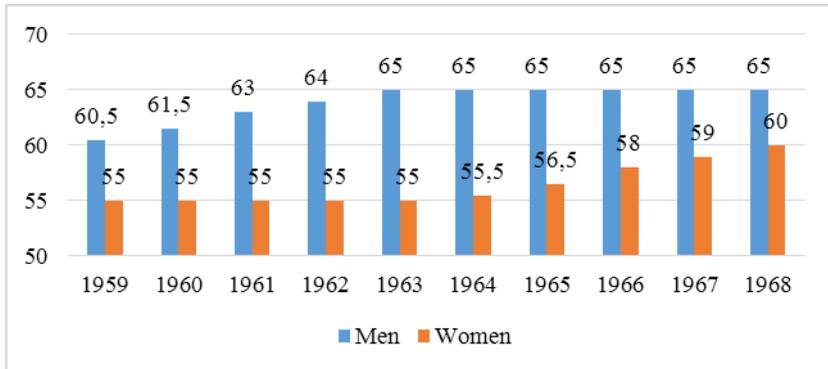


Fig. 1 – Smooth adjustment schedule for age assignment age for an old-age insurance pension.

Source: Official website of the Pension Fund of the Russian Federation [5].

Based on the first option, the average pension for 11 years has increased by 5 863 rubles or 42%. The cost of pensions would have made up more than Br7 trillion, while the increase amounted to 265 billion rubles. As a result of the second option, the growth of the average pension would reach 10 598 rubles, or 74%, while pension payments would increase by 387 billion rubles, or 124%. The total cost of pension payments from 2019 to 2030 will amount to just over 6 trillion rubles. As a result, another increase in age will have to be made.

**Discussion and Conclusions.** Demographic trends adversely affect not only the economic growth of the state, but also the economic development of companies. Due to an increase in the number of people of retirement age and a reduction in the working population, businesses may face the following problems:

- Decrease in the share of young specialists on the labor market. According to the UN in 1950, the birth rate in Russia was 14.4 million people, and in 2020 it fell by 50% to 9.2 million, so the competition for young professionals will be high, which is likely to lead to additional costs on the part of the company to attract and "keep in place" such an employee [7].

- Increase in the average age of the employee. The average age of a Russian citizen from 1950 to 2020 has increased by 15 years, reaching almost 40 years. Thus, the average age of employees has also increased, which means that the average labor productivity has decreased. It is also worth considering that older employees experience more health problems, which also affect their productivity [7].

➤ Decrease in labor productivity, which follows from the previous paragraph, will have a negative impact on the company's growth, as well as on the company's profit, which it may miss.

➤ Decrease in total demand of the population is connected with that in Russia there is a natural loss of the population. Thus, for 70 years since 1950, the rate of natural population growth has decreased from 15.9 to 0.1 per thousand people in 2020, which means that people consume less, which leads to a decrease in demand for the goods of companies, and thus a decrease in revenue [7].

➤ A shift in the structure of demand due to changes in the age structure of the population. This will affect the demand for market goods and services that are of interest to the youth and older population, with a decrease in the former and an increase in the latter.

➤ Decrease in company income and profit.

In order to reduce losses of income, and therefore profit, businesses will need to reduce costs by dismissing employees of retirement and pre-retirement age. In this case, the overall labor productivity will increase, but according to the federal law from 03.10.2018 № 352-FL "On Amendments to the Criminal Code of the Russian Federation", unjustified dismissal or refusal to hire citizens of pre-retirement age for the same reasons threatens with a fine or compulsory work<sup>5</sup>. In other words, the state tries to protect citizens from such actions on the part of companies, but the private sector itself will clearly not be satisfied with such legislation.

On the other hand, companies did not want to take people who could soon retire, and due to the pension changes that followed because of demographic trends in recent years, it makes sense to invest resources in such people, because they will have to work more time, and thus bring more profit to the company itself.

In this solution to one problem, business and the government come into conflict, as companies are interested in increasing profits, and the government is concerned about the social side of the issue, trying to protect people. However, the government and business are also interested in the economic development of the country. In the author's opinion, the solution in this case may be to unite the efforts of business and the state in order to ensure comprehensive development of human capital and stimulate economic growth. An example of such interaction could be:

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<sup>5</sup> Federal law "On amendments to the criminal code of the Russian Federation" dated 03.10.2018 No. 352-FL. - [Electronic resource]. - Access mode: <http://publication.pravo.gov.ru/Document/View/0001201810030027>

➤ In order to increase productivity it is necessary to carry out technical re-equipment of leading branches of economy and companies at the expense of business with additional state financing or tax privileges.

➤ In order to address the shortage of human resources, the state must take a number of measures in the field of internal migration of the able-bodied population from the labor surplus regions to the labor deficit ones. Businesses, in turn, should guarantee decent wages, which were in the region of the previous job.

➤ The author sees the solution of the problem in the lack of qualified personnel in the increase of jobs in budgetary organizations, including at the expense of target funds for specialties that are necessary for a particular company.

➤ The state needs to increase spending on health care, and it is also necessary to make it possible for all employees to undergo checkups annually. Businesses should facilitate checkups by scheduling time for this and, if possible, companies could introduce a voluntary health insurance system for their employees in order to provide better quality medical care.

Thus, it should be concluded that demographic trends contribute to raising the retirement age in many countries of the world, which in turn leads to negative consequences that need to be addressed jointly by government and business.

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**Аннотация.** Констатируются трудности в развитии коммерческих организаций в условиях сложившейся демографической ситуации.

Перечислены эффекты демографических тенденций. Анализируется роль демографических тенденций в повышении пенсионного возраста во многих странах мира.

**Ключевые слова:** Пенсионный фонд, демографическая ситуация, коммерческие организации, демографические тенденции, повышение пенсионного возраста.

**Annotation.** Difficulties in the development of commercial organizations under the current demographic situation are stated. Demographic trends effects are listed. The role of demographic trends in raising the retirement age in many countries of the world is analyzed.

**Keywords:** Pension Fund, demographic situation, commercial organizations, demographic trends, increasing retirement age.

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## **ESSENCE, FEATURES AND WAYS TO ATTRACT VENTURE CAPITAL IN INNOVATIVE PROJECTS**

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**Introduction.** One of the innovative sources of business financing is currently venture capital, which is the funds of third-party investors focused on new projects in the market. By offering new projects and ideas to the market, it is possible to attract investors to such projects. Venture investors usually invest in a variety of non-obvious projects and win due to the high profitability of a number of them [5]. When attracting this kind of capital, it is worth focusing on the high profitability of the business in the short term. If this is acceptable for a realizable enterprise, then there is a high chance of attracting venture investors.

**Main part.** Some representatives of the economic community associate venture business from the origin of the term "venture" (in English – risky) with enterprises of a risky nature. Some economists consider the concept of riskiness as the fact that venture capital investments do not have any guarantees against losses in an unfavorable market situation.

The most fully revealing meaning of venture business is the following definition: venture activity (venture business) is the activity of organizing between investors and companies-recipients of investment, aimed at sharing risks between all participants in contractual relations and generating income through the release of goods or products to the market [4].

Due to the application of innovations and the active use of information resources, such large companies have emerged from the once small innovative enterprises on the world consumer market, the name and products of which are known all over the world: HP, Microsoft, Apple, Yahoo, Google, Intel.

Venture activity of companies can lead the country's economy out of a crisis situation, so today the study of theoretical and practical aspects of the development of venture business is quite relevant.

One of the features of venture business is the provision of investments for a long term, which ranges from five to ten years in the time frame, and the investment of funds (investments) only in innovative products (works, services). Innovative developments allow entrepreneurs to occupy new niches in the market of goods and services. The duration of investment is determined, first of all, by the need to develop the company to such a level that when you exit, you will get a profit. Such a scheme, being a stimulus for management personnel, can also be described as one of the ways to hedge (insure) venture investments.

The difference in sources of investment capital is also a feature of venture business. Venture capital is provided by the formal and informal sectors. The formal sector is dominated by venture capital funds, which are legal partnerships and combine the resources of a number of investors: private and public pension funds (they account for more than 50% of all venture capital investments in Europe), charitable foundations, corporations, individuals and venture capitalists themselves – owners of venture funds.

Venture capital companies prefer to invest their money in companies whose shares are not traded in an arbitrary (free) sale on the stock market, but are completely at the disposal of shareholders, which can be both individuals and legal entities.

Money is invested either in the share capital of open or closed joint-stock companies in exchange for a share or a block of shares, or it is provided in the form of an investment loan, usually for a medium-term period of 3 to 7 years by Western standards.

Real practice shows that most often one can see a combined form of investment of venture companies in the market. In this type of investment, part of the money is invested in the company's share capital, and the other part is provided in the form of an investment loan. As a rule, an investor who invests his/her money in a venture business does not express a desire or wish to purchase a majority of the company's shares (a controlling stake).

This allows the venture company to strive for development constantly. All these realities are determined by the ultimate goal of the venture business owner. The owner of venture business planning to get your main income by accident a certain amount of time (sample period is about five to seven years) since the investment funds in this business, when you manage to sell its stake at a price several times higher than the initial investment, i.e. venture capitalist is not interested in long-term consolidation of the company, and prefers all the received interim profit to reinvest in the business rather than pay dividends [2].

The process of implementing the business venture consists of some stages:

- formation of new funds;
- search and selection of applicants;
- investing and living together;
- exit.

Experts in the field of venture entrepreneurship distinguish several types of investments in venture business. They are such as [4]:

- start-up investment, which is one of the risky forms of investment, divided into pre-start investment and start-up investment;
- venture capital investment initial funding (used for new organizations without the initial stage of the necessary financial resources to implement the innovation project) and subsequent stages of innovative projects (usually in cases where the company has great potential for expansion and suffers from a lack of funds);
- rescue investments that involve raising capital in those companies that have every chance of reviving their activities, but may currently be insolvent;
- replacement investments that are intended to replace part of external resources with the organization's own capital;
- investments for entering the market of a company with securities.

The most common form of investment is considered to be the investment of funds at later stages of venture business development. As a rule, this is associated with lower investor risks, a more stable position of the company in the market, and the avoidance of unnecessary expenses for expenses (obtaining a patent, licensing costs).

The main barriers to attracting venture capital in innovative projects are the following [5]:

- imperfect legal and economic environment that prevents venture companies from developing in the right direction (including legal gaps in the field of intellectual property protection);
- inefficiency of the support mechanism for small and medium-sized enterprises ;

- the use of foreign venture capital rather than Russian when implementing innovative projects;
- non effective use of venture capital companies' funds;
- personal differences between team members when creating and promoting an innovative project.
- complexity of scaling an innovative project, etc.

We can say that for the further development of innovation in Russia, it is necessary to create optimal conditions for the systematic (integrated) development of the financial services market, create an effective financial infrastructure and financial institutions that can provide financing for an innovative project at any stage of its implementation. First of all, this has to do with establishing the functioning of the venture capital investment system. Venture capital firms provide access to capital for implementation of various innovative projects.

Today, innovation is needed in everything due to a huge scientific and technical breakthrough, and financing the development of innovative projects by attracting venture capital should take place against the background of lower interest rates, against the background of expanding additional funding programs and state support for various venture companies (funds) operating in the market.

Also, creating a separate department of intellectual property expertise to issue loans and / or hiring university patent specialists (outsourcing) will help attract venture capital in innovative projects.

**In conclusion**, it should be noted that venture capital is the basis for innovative development of the country's economy and its regions, which means that for the Russian economy, an effectively built system of functioning of venture capital is one of the most promising areas of economic development. It is the state that should take all necessary measures to support the development of venture entrepreneurship in Russia and the implementation of various innovative projects involving venture capital when developing its development strategy for the short and long term.

The task today is to develop advanced technologies based on attracting funds and thereby contribute to a faster transition of Russia to the digital economy, which involves the use of innovations in all areas of state activity.

The creation of optimal conditions in Russia must be carried out simultaneously in several directions: in the legal aspect in the form of a strong legislative framework for venture business in the country, the economic aspect in the form of lower real interest rates, as it is in the context of declining interest rates, venture capital is more effective in the organizational aspect in the form of control over the development of this sector with a view to preventing violations of the antimonopoly legislation.

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**Аннотация.** В статье рассмотрена сущность и особенности венчурного финансирования, барьеры для привлечения венчурного капитала, виды инвестиций в венчурный бизнес, описаны основные пути привлечения венчурного капитала для реализации инновационных проектов самой различной направленности. Авторами предложены направления активизации венчурного финансирования в России. **Ключевые слова:** инновации, венчур, венчурный капитал, экономический рост, бизнес.

**Annotation.** The article examines the essence and features of venture financing, barriers to attracting venture capital, types of investment in venture business, describes the main ways to attract venture capital for the implementation of innovative projects of various directions. The authors suggest directions of activation of venture financing in Russia.

**Keywords:** innovation, venture capital, venture capital, economic growth, business.

UDC 336.13

## **WAYS TO IMPROVE THE EFFICIENCY OF INTER-BUDGET TRANSFERS PROVIDED FROM THE FEDERAL BUDGET TO THE BUDGETS OF THE RUSSIAN FEDERATION'S REGIONS**

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**Introduction.** Throughout the history of our state's development, socio-economic differentiation of its territories has always been present. The reasons for this inequality are both historical features of development, as well as geographical and natural factors. In this regard, a necessary condition for economic growth of the country is to ensure the uniformity of development of all its territories without exception.

**Materials and methods.** During the research, the following methods were used: the comparison method, the method of vertical and horizontal analysis.

**Results.** The structure and dynamics of inter-budget transfers provided from the Federal budget are analyzed, the main problems of providing inter-budget transfers are identified, and a number of measures are proposed to improve the efficiency of using inter-budget transfers.

**Discussion and Conclusions.** The need to provide the subjects of the Russian Federation with inter – budget transfers (hereinafter referred to as IBT) is caused by the high differences between regions in the amount of tax and non-tax revenues, low security, sources of financial resources, geographical location, and other factors. In accordance with the Budget code of the Russian Federation, the following forms of IBT are allocated to the budgets of constituent entities of the Russian Federation: grants, subsidies, subventions, and other IBT.

The analysis showed that for the period from 2013 to 2020 y., IBT account for an average of 10% of Federal budget expenditures (Fig. 1).subsidies account for the Largest share in the structure of IBT (from 40 to 49% in the period under review). In 2018-2020 y., compared to 2013 y., the volume of grants provided will increase by 8%. This dynamics shows that the level of socio-economic development of regions is falling, and their need for additional Federal budget funds is growing. Subsidies to the budgets of the constituent entities of the Russian Federation in 2013-2020 y. they occupy an average of 26% of the total volume of IBT. In comparison with 2013, the volume of grants provided decreased in 2018-2020 y., but, compared with 2015-2016 y., it increased by about 12%. since 2013 y., the volume of subventions (representing an average of 20% of all IBT) has increased, but the decrease was only in 2017 y. (the volume was almost the same as in 2013 y.). As for other IBT, their volume grew from 2013 to 2016

y. (with the exception of 2015 y.) relative to the total volume of IBT, and their decline began in 2017 y.

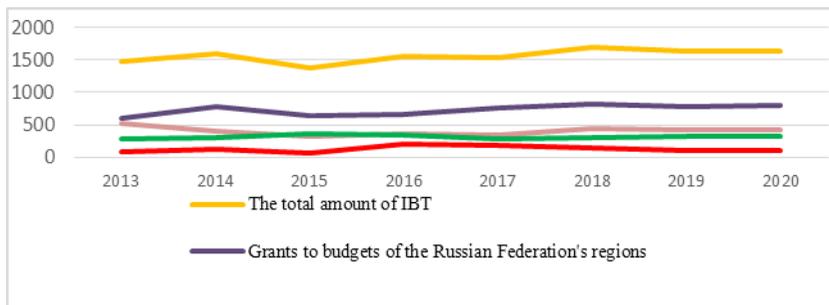


Figure 1 – Structure of IBT provided from the Federal budget to the budgets of the regions of the Russian Federation

*Source: built by the author according to Federal Treasury data.*

One of the problems with providing grants is the inefficiency of their use due to the lack of appropriate evaluation indicators. Inefficient use of subsidies confirms that currently in the Russian Federation 86 % of subjects lack their own funds. Thus, in Russia, the number of subsidized regions is 73 out of 85. This situation persists for more than 10 years in a row. Since 2017, top officials of regions receiving grants must enter into an agreement with the Ministry of Finance of the Russian Federation, which specifies a list of obligations that the region must implement on its territory.

The second problem is that the conditions for granting subsidies to equalize budget security do not meet the capabilities of all the subjects of the Russian Federation. Russian Government Resolution No. 1701 sets a requirement for regions receiving subsidies to either stop receiving subsidies by 2020, having reached the required indicators, or reduce expenditures to the level of the estimated volume of expenditure obligations of the region. If these requirements are not met, the amount of subsidies to the region will be reduced. Such conditions reduce the rights of the subjects of the Russian Federation in terms of setting the amount of expenditures within their authority, and also increase the influence of the center on the budget policy of the regions.

The directly unequal position of the Russian Federation's constituent entities regarding the conditions for receiving subsidies is expressed in the fact that a large part of the regions are subsidized solely due to the fact that in the current socio-economic conditions it is impossible to create such a system for differentiating sources of income that will provide all regions with their own tax revenues.

The third problem is the large number of subsidies allocated from the Federal budget, as well as the duplication of subsidies in certain areas. The tendency to expand state powers through the transfer of subventions exacerbates the problem of lack of financial resources in the regions for high-quality and independent performance of relevant obligations, which is caused by significant deviations in the assessment of expenditure obligations under the transferred powers.

It is important to note that in the scientific literature, to solve problems related to grants, authors often limit themselves to describing the distribution method and do not indicate their proposals [3]. Therefore, it is proposed to develop a system of indicators of the effectiveness of the use of subsidies to equalize budget security. They may vary depending on the location of the region and other factors. And already based on achievement / non-achievement of these indicators, apply the appropriate conditions for further grants to the regions.

The solution to the next problem – reducing the number of subsidies - may be to combine them. The consolidated subsidy differs in that it involves a wider choice of co-financing areas, and the recipient of the subsidy independently decides how much of the subsidy will be allocated to each co-financing area. The use of subsidies in this case is controlled by the Federation not by the amount of costs for each direction, but by the implementation of performance indicators. The practice of applying consolidated subsidies in Russia is already being implemented, for example, in the agricultural sector. Also, when forming the Federal budget for 2018-2020, the budget funds allocated for subsidizing air transport were consolidated.

The authors I.Y. Arlashkin and A.S. Gangan propose to Finance some areas not through subsidies, but through subventions [1] as an increase in the efficiency of the use of subsidies. However, this measure cannot be called effective due to the above-mentioned shortcomings in the distribution of subventions.

Improving the effectiveness of financial support for state powers transferred to regions by providing subventions can be implemented by: (1) forming a methodological basis for financial compensation to regions for additional expenses caused by Federal regulations; (2) more accurate assessment of expenditure obligations related to the implementation of the transferred powers.

As an alternative to the institution of subventions, N.A. Istomina in his article [4] suggests simultaneously assigning revenue sources to the subjects of the Russian Federation along with the transfer of powers. But in this case, the Federation will be constrained in using funds to solve common problems, although the regions will have considerable freedom in using financial resources. This will be implemented successfully only if the

planned indicators of subventions are clearly and reliably defined, which already depends on the quality of implementation of the functions of financial authorities at the Federal and regional levels, as well as if officials of control and accounting bodies will perform their duties efficiently (which is especially important in the framework of improving financial control in the Russian Federation [2]).

Considering inter-budget transfers from the point of view of their necessity to the budgets of the constituent entities of the Federation, we can conclude that their role is clearly important. Due to the prevailing economic conditions and various factors, most of the subjects of the Russian Federation are not able to ensure the implementation of their assigned powers. Thus, it is possible to increase the efficiency of the Federal budget provided IBT only in the context of a comprehensive approach, which implies the implementation of measures for each of the forms of IBT.

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**Аннотация.** В статье представлены итоги проведенного анализа структуры и динамики предоставляемых межбюджетных трансфертов из федерального бюджета бюджетам субъектов Российской Федерации. Выделены проблемы в предоставлении и использовании межбюджетных трансфертов. С учетом полученных результатов автором предложены меры по повышению эффективности предоставления и использования межбюджетных трансфертов.

**Ключевые слова:** межбюджетные трансферты, региональный бюджет, дотации, субсидии, субвенции.

**Annotation.** The article presents the results of the analysis of the structure and dynamics of inter-budget transfers provided from the Federal budget to the budgets of the subjects of the Russian Federation. Problems in the provision and use of inter-budget transfers are highlighted. Taking into account the results obtained, the author suggests measures to improve the efficiency of providing and using inter-budget transfers.

**Keywords:** inter-budget transfers, regional budget, grants, subsidies, subventions.

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## **MODERN FORMS AND SYSTEMS OF LABOR MOTIVATION IN THE BUSINESS SYSTEM**

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**Introduction.** The development of motivation and stimulation systems in business depends on national characteristics significantly. In personnel management, this dependence is observed more strongly than in other areas of management. The distinctive features of motivation and stimulation systems in Russia in comparison with the ones of enterprises in other countries are very significant in many respects.

**The main part.** The first distinctive feature of the development of motivation and stimulation systems is the fact that one model of "carrot and stick" have been widely used mainly in the production and economic activities of enterprises in the Russian Federation, which has not lost its significance today.

The second distinctive feature is that the motivation and stimulation models of our country have been and remain standardized; any deviation from these standards is considered as a violation of existing normative legal acts and local normative documents that are based and operate on the basis of these legislative acts. Therefore, top-level managers clearly observed the same principles in this area of activity (time-based, piecework-premium, premium payment systems and their varieties).

The third distinctive feature is that motivational- stimulation systems contributed to equalizing in the wage system and bonuses for managerial employees, but also maintained this trend of stimulation, since the size of managers' official salary of the same qualification category was identical regardless of the labor contribution. The same method was used for awarding bonuses. The payment of bonuses regardless of work results and even a small gap between the bonus and achieved results distort its essence and change it into a mechanical addition to the main salary.

The fourth distinctive feature of motivational-stimulating systems application is that the labor contribution was evaluated biased, formally, which led to indifference and disinterest in both individual and collective labor results; social and creative activity was reduced. The bias in the

functioning of existing systems for assessing labor contribution can be supported by the results of previous research on Russian enterprises. It should be noted that only “38.4% of respondents had said that the current assessment criteria took into account the results of labor, 50.3% – partially take into account, 11.3% – do not take into account” [3, p. 82].

The fifth distinctive feature is that the motivational and stimulating models operating in Russia completely excluded the possibility of engineering and management employees in the field of developing a non-specialized career and combining positions. It is only in recent years that the need to develop a non-specialized career and combine positions has become recognized.

The sixth distinctive feature is that social stimulation of labor activity of managerial employees was carried out mainly without taking into account individual labor results, since the social benefits of collective labor were enjoyed by both employees who achieved high performance in work, and employees who did not show special interest in labor activity. For example, the company has created an excellent social and household base (a network of pre-school, medical institutions, dispensaries and recreation centers, sports facilities, etc.). The social benefits created by collective labor were provided primarily to workers and only then to engineering and management personnel, since the main productive force was considered to be a worker, and not the intellectual ones, whose creative ideas were implemented by the workers in real life. Moreover, if an employee worked unproductive and violated the rules of internal regulations, but had a poor health, he/she was primarily provided with social benefits.

The seventh distinctive feature of motivation and stimulating systems is that none of the motivational models of enterprises in capitalist countries provided and does not guarantee a block of moral stimulations today, since they basically present ones for material, socio-material, natural and personal career. The experience of moral encouragement of the best employees, accumulated in Russia and China, deserves not only approval, but also wide dissemination at enterprises in other countries. The engineering and management corps of Russia assigns moral encouragement the second place after material.

The eighth feature of the development of motivation and stimulation is that promotion was considered in Russia, as a rule, through socialist competition. The competition should still be one of the driving motives for increasing employees' social and creative activity of in accelerating the pace of scientific and technological progress. Its necessity has been proven in thousands of defended doctoral and PhD papers, but due to the changes in political and economic situation in Russia, it is not developed or applied. In contrast to Russia, competition is now widely used by firms in Germany, the United States, Japan and other countries.

A positive example is the PRC, where competition has not lost its significance in the conditions of the socialist system and the development of market relations. It provides the high rates of economic development, which exceed the ones of the most industrially developed countries.

Considering the forms of motivation in entrepreneurship, let's consider the main trends that are visible today in our country. "The main modern forms of labor motivation are the following:

- "hygienic"-motivational theory;
- material (economic) and non-material (non-economic) motivation;
- positive and negative motivation;
- corporate and segmented motivation;
- individual motivation of key employees" [3, p. 89].

The main provisions of the "hygienic"-motivational theory, explaining the occurrence and impact of various factors on the attitude of people to the work performed, appeared as a result of the analysis of extensive information material obtained as a result of long-term observation of the behavior of employees of 12 different professions – from junior service personnel to researchers and top managers.

The group of factors called "significant motivators" and providing high job satisfaction includes:

- achievements at work;
- recognition at work;
- job content;
- the responsibilities imposed by the manual;
- professional growth.

In turn, the group of so-called "hygienic" factors that cause significant dissatisfaction at work includes:

- policy and practice of administration in the company;
- monitoring of the work performed;
- relationships with controlling managers;
- operation condition;
- earnings;
- relationships with colleagues;
- personal feelings of "comfort" in the workplace;
- relationships with subordinates;
- current status in the company;
- safety in the workplace.

The results obtained preset the original duality of the biological nature of the human personality. Human behavior is governed by two principles: animal origin and emotional. Both of these principles determine the degree of satisfaction of his/her feelings, considered in relation to the work process. Satisfaction caused by biological factors is determined by hunger, the need to protect yourself from the effects of natural disasters,

diseases, etc. Feeling of psychological satisfaction in the process of work is determined by the ability to achieve goals related to the development and growth of the individual.

Factors that cause professional development and growth are referred to as “significantly motivational” and depend on the content of activities in the workplace, determining the degree of satisfaction with their implementation. “The factors called “hygienic”, on the contrary, practically do not depend on the content of work activity and are determined by the nature of the “environment” at work, defining the degree of dissatisfaction with “existence” at work” [2, p. 44-51]

The fundamental difference between the “hygienic”-motivational concept is that the main principle for the successful real motivation of employees is the saturation of the content of the work performed in order to effectively use all the potential inherent in each employee.

We should distinguish “saturation of the work content” from a possible misconception about increasing the volume of already performed low-content work or adding mechanical operations.

“Material (economic) and non-material (non-economic) types of motivation are expressed in material and non-material stimulation. These forms of motivation are most noticeable in companies of the enterprise system” [4, p. 44-51].

Positive and negative forms of motivation have an important role in the organization's activities, since positive can increase the efficiency of work, and negative can reduce. “Identification of these forms is an important task for an entrepreneur, for knowledge of both positive and negative factors of labor motivation contributes to the personnel policy correction, as well as the formation of a motivational program of the enterprise” [1, p. 73-84].

Corporate and segmented motivation is characterized by the creation of a motivational program, respectively, both for the enterprise (group of enterprises) as a whole, and for its individual structural divisions and categories of employees. For certain categories of employees, it is advisable to create separate motivation programs, since the work of workers, specialists and managers has its own specifics, the difference in the investment of labor efforts.

Individual motivation of key employees means that only the motivational program will be effective, in which the attention paid to the achievements and merits of an individual specialist is associated with management goals, as well as with a democratic form of determining the best specialists.

**Conclusion.** Thus, in order to provide the stability of business activity, it is necessary to form motives for internal behavior based on creating clarity of value orientations and creating conditions for the adoption of innovations.

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**Аннотация:** В настоящее время система мотивации должна отвечать требованиям, предъявляемым к ней со стороны бизнеса, а так же предъявляемым требованиям со стороны человека. Для создания эффективной системы мотивации и стимулирования труда персонала необходимо, прежде всего, определить её ценности, на основе которых формируются цели предприятия и его будущее развитие.

**Ключевые слова:** национальные особенности, трудовые стимулы, система мотивации труда, производственно-хозяйственная деятельность, коллективный труд, профессиональное развитие, материальная (экономическая) и нематериальная (внеэкономическая) мотивации, ценностные ориентации, индивидуальная мотивация.

**Annotation.** The motivation system must meet the requirements imposed on it by the business, as well as ones presented by a person. To create the effective motivation system and labor stimulation for the staff, it is necessary, first of all, to determine its values, on the basis of which the enterprise's goals and its future development are formed.

**Keywords:** national characteristics, labor stimulation, labor motivation system, production and economic activities, collective labor, professional development, material (economic) and non-material (non-economic) motivation, value orientations, individual motivation.

UDC 338

## **MATERNAL CAPITAL AS A TOOL FOR IMPROVING THE DEMOGRAPHIC SITUATION IN THE RUSSIAN FEDERATION**

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**Introduction.** In a global competitive economy, the Russian Federation is striving to achieve high economic performance (for example, joining the top five economies of the world), scientific, technological and socio-cultural development. Over the past decade, Government programs have been adopted for the comprehensive development of Russian society (such as national projects). All this shows that Russia is interested in obtaining the status of a developed nation. The question of having developed labor force and intellectual resources is becoming relevant in this regard. The demographic situation has become a matter of interest for the Government, as it can have a significant impact on the population of the country and consequently on the fulfillment of public objectives.

That is why the aim of the study is to examine both the current demographic situation in Russia and the instruments of influence on it.

**Materials and Methods.** The study presented in the article is based on examination of legislative acts on measures to support families with children and comparison of the theoretical conclusions proposed by Russian scientists (on the state of the demographic situation [2, 4, 6, 8] and the impact on it of the maternal capital [1,5]) and official quantitative demographic indicators, provided by the Statistical Committee of the Russian Federation [7].

**Results.** The demographic situation in the Russian Federation is of interest to many scientists. In the paper of E.S. Poluhina, the situation in the demographic sphere is evaluated as «critical». The causes include the deterioration of the institution of the family, depopulation, high levels of social inequality, poverty, and the lack of guarantees of state support for young families. The author identifies two types of causes affecting demographic processes: socio-economic and moral. E.S. Poluhina concludes that without appropriate intervention by the Government, it will not be possible to change the situation [4].

I.V. Balyinin notes the differences in the demographic development of the regions of the Russian Federation [2]. In A.V. Sozin's article, the demographic situation in Russia is characterized as «problematic», and the trends towards its change as «negative». The author concludes that the particularities of the demographic situation in Russia are premises for a more serious development of social and economic institutions [6].

V. P. Chichkanov, A. V. Vasilyev, G. P. Bystray and S. A. Ohotnikov, in a study on the evaluation of demographic development in Russia, conclude that there is a need for State regulation of demography, aimed at improving the health and life expectancy of Russians. They justify the need not only for federal but also for regional population development programs [8].

Let us turn to the population projection up to 2035 [7]. Two indicators were studied: the birth rate and the natural increase in the population.

According to the «realistic» forecast (figure 1), the birth rate in the next 20 years will not leave the interval of [1,4; 1,6]. This situation, which in other conditions could be characterized as «stability», considering the processes of natural decline of the population begins to be characterized as depopulation.

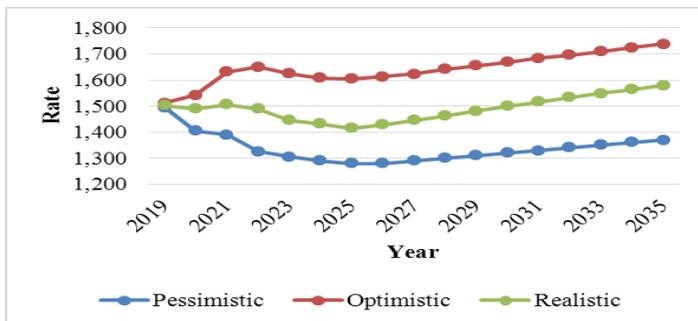


Figure 1 – Forecast of fertility rate 2019-2035 [7].

According to figure 2, the natural decline of the population peaks in 2026-2027 y. However, the birth rate, according to figure 1, has been increasing since 2025. This gap is existing because of effect of the increasing birth rate during this period is outweighed by the high mortality rate of the population. A comparison of the average mortality rates for the period 2019 – 2027 y. and 2028 – 2035 y. (1.782 and 1.717 thousand people per year according to the statistics [7]), shows that the mortality rate plays key role in characterizing the demographic situation in Russia.

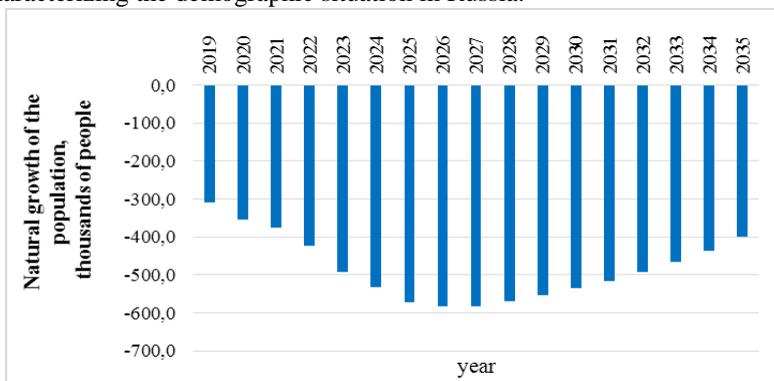


Figure 2 – Forecast of natural population growth 2019-2035 [7]

However, in the context of improving the demographic situation, it is necessary to analyze not only the quantitative but also the qualitative aspects of the issue. In such a case, it is important to examine the conditions under which children are born and raised.

Based on the 2017 data, about 26% (!) of children live in households with average per capita income below the subsistence level. However, 81% of considered poor households have at least one child. About 20% of all households with children are poor. The fact of concern is that about 30% of households with children under 3 years of age are poor [7]. These data justify that in solving the demographic problem it is important not only to «increase the number», but also to be particularly responsible to those already born children who cannot exist without State assistant. It will not be able to supplement the healthy and intellectually developed working population of the country without intervention in demographic processes.

The urgency of the problem requires the development and creation of instruments for population recovery based on two pillars: the promotion of fertility and long-term support for the family after birth of a child.

Maternal (family) capital is an example of an instrument for complementary support to the family. In accordance with the legislation, the maternal capital is a measure of State support for families in which the child was born (adopted) in the form of the allocation of a target monetary amount to the household. This amount can be used in the number of patterns (figure 3).

In the scientific community this instrument has been generally well received. Thus, V.N. Arkhangelsky, Y.V. Zinkina, A.V. Korotayev and S.V. Shulgin analyze the effectiveness of the capital and conclude that fertility rates for second children have increased significantly since the introduction of the maternal capital program [1]. L.A. Popova points out that the maternal capital program has not only a positive quantitative effect on fertility, but also contributes to raising the reproductive habits of the younger generation [5].

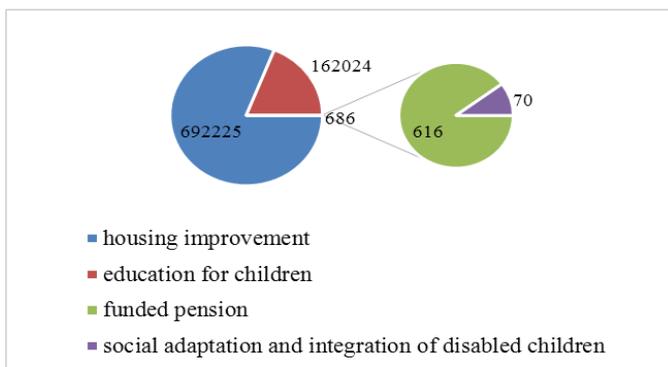


Figure 3 – Uses of maternal capital in 2018, people [7].

Looking at the figure, the positive experience of the maternal capital has become a basis for additional support measures for families with children, based on the targeted use of funds. For example, at the end of 2019, the Government offered «first September capital» - a subsidy to families with schoolchildren to cover the expenses that arise in families when preparing a child for a new school year [3].

**Discussion and Conclusions.** Thus, State policy aimed at achieving natural population growth (or a reduction in decline) in the Russian Federation is faced with two tasks: an increase in the birth rate and a reduction in mortality. Since even during the period of the natural decline of the population (2027-2035 y.) its significance is not close to zero, there is every reason to agree with the scientific community that the demographic situation in our country is problematic.

Despite maternal capital was appreciated by both the scientific community and the population of the country have been positive in terms of the increase in the number of children born in second-born families, the Government is continuing to modernize this instrument. In addition to the annual indexation and some additions to the spending capacity, the most important improvement is the extension of the program to the first of born children.

Nevertheless, there are still features in the current program that need to be improved. The modernization of the capital should take three forms:

1) Modernizing current spending patterns.

A key element in improving the current productivity of the program could be an expansion of the range of goods and services that can be purchased by the certificate holders, who use the certificate for the social adaptation and integration of children with disabilities. According to statistics (figure 3), this is the least popular area. It is possible that the expansion of the

list of goods for disabled children allowed for purchase make maternal capital a serious measure of support for families with disabled children.

A separate element of maternal capital spending is the monthly cash payments to poor families. However, this payment may expose the family to difficult choices about improving their current or future assets. In fact, the income criterion of a family deprives it of its right to those very «additional» support measures, the provision of which is the purpose of the program. It is advisable to take this payment out of the program and to finance it from the State budget, in the same way as the monthly payment for the birth of the first child. This innovation will allow to significantly expand both «current» and additional possibilities of poor families.

#### 2) Introduction of new spending patterns.

As mentioned above, one of the objectives of the program is to improve the quality of life of families with children. The introduction of new productive spending patterns can increase both the quality of opportunities for families with children and have a significant psychological impact on families wishing to have children. Among the new directions: the possibility of obtaining medical services for parents and children, acquisition of a motor vehicle by the family, etc.

#### 3) Increasing the number of times to obtain maternal capital.

Until the beginning of 2020, the capital could be obtained once in a lifetime. The obvious way to modernize the program would be to give a right to families to get maternal capital both for the first and the second child. This possibility can be implemented in different ways. One possibility would be to introduce an income criterion for obtaining a second certificate.

Thus, the maternal capital program, taking into account both the changes already made and the potential changes in its implementation, can have a long-term impact on the quantitative and psychological aspects of fertility, raising the birth rate and strengthening the confidence of the family in the desire and ability to have children. No less important direction of social support for families with children is «ongoing» support aimed at improving the quality of life of the family at the present time and implemented, if necessary, through a system of monthly (or other periodic) state benefits. Together, the development of «ongoing» and additional State support measures can have a significant impact on the birth rate in Russia and become a tool not only for reducing decline, but also achieving sustainable natural growth of the Russian population.

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**Аннотация.** В статье обосновываются демографические проблемы России посредством результатов проведенного анализа количественных значений демографических показателей, таких как рождаемость и смертность населения. Дается характеристика демографической ситуации в России. Особое внимание уделено оценке качества жизни семей с детьми. Представлен авторский взгляд на совершенствование программы материнского капитал как одного из ключевых инструментов социальной поддержки семей с детьми в Российской Федерации.

**Ключевые слова:** демография, демографические проблемы, демографическое развитие, семьи с детьми, материнский капитал

**Annotation.** The article justifies demographic problems in the Russian Federation by analyzing the quantitative values of demographic indicators, such as birth and mortality rates. Demographic situation in the Russian Federation is characterized as problematic. Special attention is paid to assessing the quality of life of families with children. The author's view of the improvement of the maternal capital program as one of the key instruments of Government support for families with children in the Russian Federation is presented.

**Key words:** demography, demographic problems, demographic development, families with children, maternal capital

**PROBLEMS OF EFFICIENCY OF BUDGET INVESTMENTS IN  
THE RUSSIAN FEDERATION AND WAYS TO SOLVE THEM**

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**Introduction.** The purpose of this work is to search for problems of efficiency of budgetary investments and to offer possible variants of their solution as the problem of economic growth and development is now brought to the fore. While some countries are currently experiencing slowdown in growth, others (e.g. China) are reviewing their macroeconomic development strategies. As you know, our country has adopted a macroeconomic policy to maintain investment activity, which is aimed at eliminating Russia's potential lagging behind other countries in the world, which cannot be achieved without efficient use of budget funds.

In turn, the efficiency of the use of budgetary funds directly depends on the quality of control activities carried out by government agencies and local governments. Therefore, the main purpose of state financial control, first of all, by ensuring through it expediency and legality of financial operations, is to increase the efficiency of budget funds use.

**Materials and methods.** Theoretical basis for this work was the materials of domestic scientific articles, information base - data from the Accounts Chamber of the Russian Federation. The research was conducted using general scientific and special methods.

**Results.** First, let us consider the data provided on the official website of the Accounts Chamber of the Russian Federation [4], which refers to violations of the use of budgetary funds by the Ministry of Culture of the Russian Federation. "The balances of budget investments not spent by the Directorate of the Ministry of Culture have grown from 100m to 2.8bn rubles over three years. In 2018 80% of the increased funds were not used"<sup>6</sup>. - said the auditor of the Accounts Chamber, Mikhail Men. The growth of unspent cash balances indicates the problem of late commissioning of capital

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<sup>6</sup> Interfax. Available at: <https://www.interfax.ru/russia/655097> (accessed 19 May 2020)

construction facilities. Thus, 13 out of 14 projects were not commissioned on time in the period from 2017 to 2018. According to the Accounts Chamber, the reason is the lack of competence of design companies, as well as the low requirements of the Ministry of Culture to the experience of participants in public procurement. Taken together, this leads to excessively frequent adjustments to the projects, their cost increases, and delays in the deadlines.

Unfortunately, this problem is not an isolated case. As the author's analysis of the data of the Accounts Chamber of the Russian Federation showed, the percentage of commissioning of facilities is extremely low (Fig. 1). Now, there are about 70,000 objects in the unfinished construction with the total amount of investments exceeding 5 trillion rubles. These are investments both in planned projects under construction and in "problematic" projects - "abandoned" and "long construction". The share of the latter in the total amount of money invested is 28%, and in the total amount - 13%. These objects are the fruitlessly spent budget funds, and the buildings themselves worsen the urban environment, creating inconveniences for residents. Thus, one of the most important tasks in the sphere of social and economic development of the state is to increase efficiency of budget investments, including by means of minimization of unfinished construction. This can be achieved by strengthening state/municipal and public control at all stages of project implementation. If there are no guarantees of return on invested funds, the project should not be implemented. In addition, it is necessary to establish some responsibility for the failure of the planned indicators, both economic and social. For example, a return mechanism should be developed if the goals set in the project have not been achieved. A necessary element should be the consideration of operating costs (in the process of project implementation) when assessing the planned project. If the project does not guarantee that the funds invested in the project will be repaid within a reasonable period, it does not need to be fulfilled, and there should be a certain responsibility in case of failure to meet the expected socio-economic indicators.

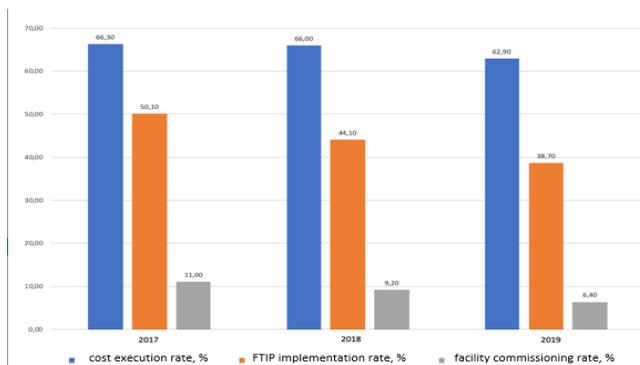


Fig. 1. Analysis of the data of the Accounts Chamber of the Russian Federation

*Source: built by the author based on the data of the Accounts Chamber of the Russian Federation*

According to the author, in order to solve the identified problems in the sphere of budget investments, it is necessary to have a concrete action plan. Its necessity is conditioned by limited resources and, as a result, by the need to set priorities.

At the same time, special attention should be paid to the assessment of the efficiency of budgetary investments through the practical use of a set of socio-economic indicators. Thus, depending on the direction of investments, examples can serve as examples:

- living standards of citizens. This level is largely determined by the quality of education, the degree of environmental safety and satisfaction of social and cultural needs of society. All the above indirectly or directly affects the main complex characteristic of living standards - the Human Development Index (HDI);

- corporate indicators of investment success (Profit, ROE, ROA FCF). In the case of state corporations, attention should be paid to the excess of these indicators over the industry average. It should not be forgotten that in the framework of public private partnerships, these investments should not only be profitable, but also socially significant, and the indicators of importance are at the forefront. For example, the efficiency of toll roads of federal importance will be determined not so much by their payback period as by the brought social effect.

When considering the problem of increasing the efficiency of budget investments, one should not focus solely on its economic aspects. One of the possible ways to improve the situation may be to increase budget transparency of investments. Every citizen, who properly pays taxes, has the right to know where the budget funds were directed and how rationally they were used. This can be achieved by improving the electronic portal of the unified budget and various investment programs. This measure will have a positive impact not only on public finance management, but also on financial literacy. It is important to note that well-designed and informative Internet resources will create a dialogue between the state and society, which will have a positive impact on both sides of the communication. It seems that against this background, the state will be able to partially get rid of the popular opinion about misuse of budget funds, as well as to increase the level of trust of the population (which, in turn, will affect other factors; for example, an increase in the level of investment activity of the population, including investment in FLB for public).

To consider the increase of budget transparency at the expense of improvement of the electronic portal it is possible on an example of a site of the Federal address investment program [5] where it is possible to achieve desirable result at the expense of elimination of the following problems:

Problem 1: Visual component of the portal. The data provided on the site are difficult to visualize due to "dryness" and homogeneity.

Problem 2: Lack of a hotline.

Problem 3: Lack of a question and answer section.

Problem 4: Lack of substantiation for the specific project implementation.

Problem 5. Absence of a possibility to track the implementation of the set tasks.

### **Discussion and Conclusions.**

Speaking about solving the identified problems, the following measures should be taken:

1. Dilute the content of the resource with charts and tables to improve intuitive perception;

2. Create a call-center for receiving and processing requests. It is important to note that the hotline also provides financial literacy for the population. Also, thanks to prompt access to financial-literate comments, it is possible to protect people from stereotypical views on misuse of budget funds, showing them transparency of financial transactions.

3. Create a "question and answer" section on the portal. It will solve several problems through the availability of answers to the most frequently asked questions:

- to help citizens learn more about this investment program;
- reduce the load on the support team;
- will help you navigate and search for information on the website.

4. Place on each investment project page a document justifying the feasibility and amount of money provided.

5. Track the process of capital construction objects construction with the help of video cameras operating in 24/7 mode. This method of control is used in many construction companies, where the official website has the ability to monitor the construction of a particular house. This format of control can only be used for construction and reconstruction of objects. In case of technical re-equipment, it also seems expedient to attach reports containing information on interim results to the programs. They should be simple and understandable for all citizens. Also, in addition to all the above, it is necessary to add to the portal a percentage scale showing the degree of work performed.

6. Finally, in addition to the previous two items, the expected investment consequences for each project can be added to the portal (also in the format of attached documents or hyperlinks). These documents must

show exactly where the investment will take place. With these measures, citizens will understand not only where the budget is spent, but also the social and economic impact on society.

Thus, ensuring greater efficiency of budgetary investment can only be achieved by using a set of proposed recommendations. According to the author, the proposed measures will allow competently and effectively put into operation new objects of capital construction, reduce the volume of unfinished construction and increase the efficiency of budget expenditures.

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**Annotation.** In this article the author raises the problem of efficiency of budget investments in the Russian Federation. It is conditioned by the considerable influence of budgetary investments on the level of social and economic development of the country. On the basis of the conducted analysis the key problems are designated, measures for their solution are proposed. At the same time, the author pays special attention to the proposal of possible ways of solving the problem related to the transparency of budget expenditures.

**Keywords.** budget investments, Court of Accounts, budget transparency, federal targeted investment program.

**Аннотация.** В данной статье автором поднимается проблема эффективности бюджетных инвестиций в Российской Федерации. Обусловлено это значительным влиянием бюджетных инвестиций на уровень социально-экономического развития страны. На основе проведенного анализа обозначены ключевые проблемы, предложены меры по их решению. При этом, особое внимание автором уделяется предложению возможных путей решения проблемы, связанной с обеспечением прозрачности бюджетных расходов.

**Ключевые слова:** бюджетные инвестиции, Счетная палата, бюджетная прозрачность, федеральная адресная инвестиционная программа.

## SECTION 7: MILITARY INTERPRETING



UDC 811.161.1

### **CORPUS APPROACH TO THEORETICAL AND APPLIED ASPECTS SOLUTION OF MILITARY INTERPRETATION**

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The corpus approach is considered to be a promising method of linguistic research aimed at the applied study of language and its functioning in real texts.

Today, there is a contradiction between the public's need for high-quality of military interpretation and the search for ways and means to provide such quality. The ability of a translator to assess the quality of the translated text independently is one of the problems in modern translation theory and practice. Developing self-control skills in translators is a particularly important task. Interpretation is not only a text transformation; it is a complex process of transforming the phenomenon of a skill set, analyzing possible inaccuracies and errors by using existing sources of linguistic information. On the one hand, different dictionaries solve lexical and grammatical problems, but on the other hand, they have a limited scope and require a certain amount of time to find a lexical and grammatical unit.

Thus, there is a problem of searching resources of linguistic information and approaches to solving translation problems that can reduce the translation time and ensure the quality of text interpretation. To solve this problem it is necessary to apply a corpus approach in translation problems decision, which is based on the use of electronic text corpora – huge arrays of natural texts in a foreign language, collected on a magnetic medium and properly ordered and marked for faster search of linguistic information.

The purpose of this article is to determine the possibilities of using corpora in the process of translating English military texts.

All military translators need in resources, the potential of which could help to identify factors that affect the quality of the translated text. Special characteristics presence in the texts that characterize the units of a foreign language text is the main feature of language corpora.

The main role of corpora is to provide the most correct examples of the use of language units that reflect both the complexity and features of the natural language. The main purpose of the corpus of texts is to show the functioning of linguistic units in the context of a large material and in their natural environment – contextual one [1].

The corpus is defined by scientists as a set of authentic texts selected as representative of a particular language or as a set of written or oral texts that are stored on a computer [6]. A special feature of the corpus is a fundamental collection of texts available for qualitative and quantitative analysis of the translated material [7].

Corpus linguistics was studied By V.P. Zakharov [2] and P.V. Sysoev [3]. T. A. Chernyakova researched the methods of forming students' lexical skills on the basis of the linguistic corpus [4]. The theory and practice of corpus linguistics was studied by M. Baker [6], D. Biber, S. Conrad, and R. Reppen [7], Chul-Kyu Kim [8]. The issues of language and translation training on the basis of corpora were considered by K. Aijmer, B. Altenberg, M. Johansson [5]. The role of buildings in improving the effectiveness of learning vocabulary in the academic environment was stated by Konul Hajiyeva [10]. Features of the article language based on the corpus approach are defined by A. Gilmore, N. Millar [9].

Today, Wikipedia or Word Net has been replaced with a new approach based on linguistic corpora. There are many bilingual or multilingual corpora, including OPUS (an open source parallel corpus) – a collection of translations on the Internet [12], the placement of corpora, and the addition of linguistic information.

OPUS is a growing collection of translated texts from the web. In the OPUS project we try to convert and align free online data, to add linguistic annotation, and to provide the community with a publicly available parallel corpus. OPUS is based on open source products and the corpus is also delivered as an open content package. Data files for all language pairs in different formats and with different kind of annotation (if available) can be downloaded. OPUS also provides pre-compiled word alignments and phrase tables, bilingual dictionaries, frequency counts, and these files can be found through the resources search form on the top-level website of OPUS [13]. OpenSubtitles also includes intra-lingual sentence alignments between alternative subtitle uploads in the same language.

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Picture 1 – Open Subtitle Corpus

Источник: <http://opus.nlpl.eu/OpenSubtitles.php>

A parallel corpus consists of the same text translated into one or more languages. Texts are aligned (normal sentences are linked).

There are two types of parallel corpora in modern corpus linguistics:

- 1) Comparable (Multilingual) Corpora;
- 2) Translation Corpora.

The corpus can be used to compare the use of a language by a native English speaker and a student who is learning a given language; compare styles of English; learn and compare spoken and written language; learn word order in sentences. The corpus approach can be a way to solve the difficulties associated with choosing a grammatical construction.

The parallel corpus of English texts when translating military texts makes it possible to find a way to eliminate errors in the use of lexical and grammatical compatibility. Corpora allow to select possible equivalents of the studied vocabulary, meaning in contexts. For example, corpus-based lexicographic analysis clearly helps to reveal the contextual use of certain words, especially synonymous ones.

In the corpus of English and Russian languages, as well as using the concordance system (for example, the Sketch Engine program), search of requested word and get the answer in a new window in the form of fragments of sentences from different texts. The meaning of a given word is considered in the context of its use in the language, which gives more bases for confidence in its use.

One of the didactic properties of the linguistic corpus is the contextuality of search results. While searching a word in the corpus, the

concordancer program (concor-dancer) or corpus manager (corpus manager) offers a choice of ways to use words in contexts in the original language with possible options for the translated language.

To work with multi-valued abbreviations, it is quite reasonable to use parallel cases, since the values can be completely different. For example, the abbreviation "ACC" can have about 20 different meanings in English (police, government, army, criminal, war, ministry of defense, ocean, ocean science, climate, military logistics, navy, networking, technology, government). Accordingly, working with abbreviations and abbreviations requires an analysis of the actual context of their use.

One of the problems for military interpreter is compatibility selection. So, having decided on the translation of the noun, it is necessary to choose a verb that is combined with the specified phrase in a certain context. By setting the phrase "preliminary review" in the corpus system, one can get a translation that will allow to use the verb to the noun with confidence, specifying it through the context.

*Mounting headquarters is one which is designated and has accepted responsibility for planning, monitoring, controlling, deconflicting and coordinating movement and transport to facilitate the deployment of a multinational headquarters from its home base to points/ports of embarkation, and then monitoring the deployment to points/ports of disembarkation/debarkation.* *Мобильный штаб обеспечения перевозок – это штаб, выполняющий в соответствии с полученными указаниями и принятыми обязательствами задачи планирования, контроля, управления, согласования и организации взаимодействия при перевозках и транспортировании многонационального штаба с места постоянного базирования в места или порты посадки (погрузки), а также осуществляющий контроль за его передислокацией в места или порты высадки (выгрузки) или пересадки (перегрузки) [11].*

The corpus of parallel texts allows to determine the exact meaning of words and phrases for a specialized text. They can serve as an effective tool as glossaries.

*The term "logistics" means the science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, the aspects of military operations are included [11, p.193].* *Термин "логистика" означает принципы планирования и осуществления перевозок и содержания войск. В самом широком смысле включает все аспекты военных действий [11, с.193].*

The corpus is necessary to search equivalents of terms, since they are an important source of linguistic information. Modern terminology reference books do not always provide accurate translation. Parallel corpora of translated texts are the resource for automatic extraction of terms and terminological word combinations.

*Homing head* is a self-contained device mounted on the warhead vehicle to ensure a direct hit on the target or a hit close enough to destroy it.

*Головка самонаведения* – автономное устройство, устанавливаемое на носителе боевых зарядов для обеспечения прямого попадания в объект атаки (цель) или сближения с ним на расстояние меньше радиуса поражения зарядов [11].

Lexicographic analysis, which is based on corpus analysis, reveals systematic differences in the use of prepositions (or other official parts of speech).

*European Defence Agency (EDA) Established in 2004 to help EU Member States develop their defence capabilities for crisis management operations under the European Security and Defence Policy.*

*Европейское оборонное агентство было создано в 2004 году с целью содействия государствам-членам ЕС в развитии оборонных потенциалов для проведения операций кризисного регулирования в рамках Европейской политики безопасности и обороны [11].*

**Conclusion.** There is a need to review such valuable translation tools as corpus language programs that provide a selection of texts on a given topic, including parallel texts in different languages. Corpora can be used in the process of translating English military texts. Projects of parallel buildings have a significant application potential in the methodology of teaching foreign languages and translation. OPUS an open source parallel corpus allows users to search bilingual and multilingual data in many languages, find concordances, collocations, word list and more. When searching for a word in the corpus, the program-concordancer or corpus-manager offers a choice of word variants in contexts in the original language with possible meanings in the translated language.

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**Аннотация.** Рассматриваются возможности применения корпусного подхода в процессе перевода военных текстов на иностранном языке. Параллельные корпуса позволяют значительно сократить временные затраты на интерпретацию сложных текстов и предоставляют образцы военного перевода путем изучения переводческих приемов и способов.

**Ключевые слова:** корпус, параллельные корпуса, военный перевод, контекст, военный текст, корпусный подход.

**Annotation.** The article considers the possibility of using corpora in the process of translating military texts in a foreign language. Electronic parallel corpora can give possibility to translate difficult texts more quickly and provide samples of military translation by studying interpreting techniques and methods.

**Keywords:** corpus, parallel corpora, military interpretation, context, military text, corpus approach.

UDC 811.161.1

**WHAT IS MILITARY INTERPRETING?**

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It is customary to distinguish three types of translation: artistic, socio-political and special, i.e. translation in any professional sphere. Military translation is a type of special translation [3]. In modern conditions comprehensive international military-political cooperation, military translation may be closer to socio-political translation.

From the point of view of stylistic specificity between texts there are no significant stylistic differences in the subject matter [1]. These are mostly scientific and technical texts or official business texts. There is a predominance of military thematic component. In addition, they use little figurative and emotional means of expression. The main task of a military text is to give the recipient specific information [2].

“Military interpreter is a commissioned officer of an armed force who interprets and/or translates to facilitate military operations” [4, www]. The military text as an integral and multi-sided formation has repeatedly been the object of linguistic research.

In military translation, the most concentrated form reflects the characterological features and properties of all subspecies of translation in various areas of professional communication: scientific, scientific-technical, legal, medical, and many others, but, in addition, and journalistic, and even artistic. As its object, military translation has the so-called "military speech", i.e. all those speech works that are generated by the military or for the military, in specific conditions of communication. Military speech, therefore, can be considered as a specific form of speech communication inherent in a certain professional community, united by the commonality of the subject of their activities.

In this communicative sphere, specific variants of various functional and communicative systems are found: military-official, military-scientific, military-journalistic, military-artistic types of military argot, military-historical and similar variants of well-known functional styles. A clear distinction between these military variants of functional styles allows, in turn, to identify the presence of certain common characteristics that form the distinguishing features of the corresponding variants.

Many scientists such as A. N. Kozhina, P.N. Denisova, A.V. Myrtova, F.P. Filina, N.V. Garbovskiy, E.N. Meshkurov studied military text translation.

Military terminology is one of the most important, most fruitfully developed, but not the only object of the theory of military translation.

The analysis of highly professional translation works allows to establish the main requirements, in particular, for written military translation. These include:

- preservation of the source's professional conceptosphere, its informative and objective completeness in the translated text;
- accurate unambiguous logically correctly expressed verbalization of the meaning of the original content by means of foreign language;
- correlative selection of terminological nomenclature, correlated standardized symbols, abbreviations and abbreviations, special signs-indexes and symbols, etc.;
- saving the style-forming characteristics of the original in translated text;
- reproduction of the normative architectonics (structure) of a original language into other language (with the necessary comments if there are significant compositional discrepancies in the construction of the military text in a original language).

Interpretation should reproduce the discursive-unambiguous (non-variant) wording of the content and form of military speech statements such as instructions, orders, orders, commands, etc. with their clearly determined purpose and predicted addressee (for example, instructors of military courses for foreign military personnel, foreign legion commanders, etc.) perlocative effect — the expected reaction of the addressee to the will of the commander, chief, senior military rank, etc. “Military interpreting has always been around and it is expected to continue to be an essential component of the armed forces. Languages may change and tactics could differ, but the profession as such will remain basically the same” [4, www].

It is obvious that a military translator must be an extraordinary person in his/her professional sphere. It is necessary to know all the details of the military terminology systems of the foreign-language, to be aware of the isomorphic and allomorphic properties, to be competent in the national peculiarities of military affairs, including the concept of foreign military doctrine.

The military translator, in particular, must possess the skills of two-way, phrasal, consecutive and simultaneous translation, be able to work with military documentation and correspondence, quickly and efficiently refer and annotate military, military-technical and military-political texts. In addition, they need to have special skills such as translating radio communications, collecting and processing information transmitted by various technical

means, etc. “Behind the lines interpreters play an important role in logistics and diplomacy. When an elected official visits a military base, military interpreters serve as escort interpreters for said dignitaries. They also participate in media relations with local news agencies, and in the acquisition of supplies from local merchants” [4, www]. They have been essential to historical events in the world. Military interpreters do simultaneous interpretation as well as sight translation. “Sight translation is a very important part of their work. There are two kinds of sight translation: The “traditional sight translation” used primarily for strategic and intelligence purposes, and the more widely used summary sight translation. This type of sight translation is used during house searches, enemy searches and searches of local civilian population” [4, www].

Military texts have their own characteristics, which are not only the specifics of language tools, but also their extremely high informative content. texts should be labeled exclusively as "cognitive-informational", whereas their functional and stylistic range is much broader and is not limited to a purely military-technical variety.

To ensure a communicative act within the military sublanguage, the translator must take into account the features that characterize communication as strictly institutional: status-role relations of communicants, high terminology, clarity and structure of speech. In other words, both in the institutional discourse as a whole and in the specific military sublanguage, the translation must be context-oriented.

Military vocabulary is the basis of the phenomenon of military discourse. Therefore, for effective communication within the framework of military discourse, the possession of military vocabulary is one of the main competencies of a military linguist. One of the main characteristics of the military sublanguage is its "cliched" - clear regulation and structuring. There are several explanations for this fact - from the banal need to minimize the time for transmitting and receiving commands in combat conditions to the desire of military collectives to maximize the preservation of military traditions and rituals.

In military style, epithets, tropes, and stylistic figures are widely used. Intertextuality is expressed primarily in explicit and implicit quotations.

In conclusion it should be noted that military interpreters work under a different code of professional responsibility. They are ethically bound to do a professional job, to interpret with accuracy, to prepare for the assignment and to interpret to the best of their ability [4].

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**Аннотация.** Изучены основные компетенции военного переводчика для осуществления эффективной коммуникации в рамках военного дискурса. Отмечено, что в военном переводе отражаются черты и свойства всех подвидов перевода в самых различных сферах профессиональной коммуникации: научного, научно-технического, юридического, медицинского, публицистического и даже художественного. Охарактеризованы основные требования, предъявляемые к письменному военному переводу.

**Ключевые слова:** военный переводчик, военная терминология, коммуникация, военный дискурс.

**Annotation.** The main competences of a military translator for effective communication within the framework of military discourse are studied. It is noted that military translation reflects the characterological features and properties of all subspecies of translation in various fields of professional communication: scientific, scientific-technical, legal, medical, journalistic and even artistic. The main requirements for written military translation are described.

**Keywords:** military translator, military terminology, communication, military discourse.

## SECTION 8: PHYSICS, BIOLOGY AND ECOLOGICAL PROBLEMS



UDC 57.04

### ENVIRONMENTAL CONDITION OF THE SMALL RIVER BULGANAK IN KERCH

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**Introduction.** Small rivers (up to 100 km long), which account for a significant part of the surface runoff of Russia, are most susceptible to anthropogenic impact. A peculiar component of the geographical environment, small rivers play a significant role as a regulator of the water regime of certain landscapes, maintaining equilibrium and redistribution of moisture. The main feature of the formation of small rivers' runoff is their close connection with the landscape of the basin, which determines the easy vulnerability of these waterways not only with excessive use of water resources, but also with the development of the catchment.

The aim of the study is to research the ecological state of the small river Bulganak of the city of Kerch and to determine the sources of its pollution.

**Materials and research methods.** In fulfilling the purpose of the study, the following methods were used: field (sampling, observation); bioindication; statistical; Earth's remote sensing.

The object of study is the small Bulganak river.

The subject of study is the ecological state of the water body and the factors influencing it.

The Bulganak is a small river, 7 km long, located on the territory of the Kerch Peninsula. The source of this water body is located north of the village of Bondarenkovo and flows through the village of Egorovo and the city of Kerch where it disembogues into the Kerch Strait [5, 6]. One of the

environmental problems of this water body is drainage due to climatic changes. There is generally no water in the Bulganak only after rainfall small streams appear. The amount of precipitation does not exceed 400 mm per year. The water regime of the river is practically not studied. Nourishment of the river occurs due to precipitation. Some years short-term flash floods are superior to winter and spring, most often they occur in June - July and pass for several hours. The height and intensity of floods in the lower reaches of the river increases due to a decrease in leakage losses due to salinity of soils in summer and their freezing in winter [3].

In the course of determining the toxicity of the waters of the Bulganak River using the Growth Test method [1] samples were taken at three monitoring points the common wheat culture (*Triticum vulgare*) was selected as a bioindicator: 1. Source (Bulganak pond); 2. Midstream (near the school № 15); 3. Mouth (Gorky St.). The results of the study on the height of the plants and the length of the roots are shown in the table 1.

Table 1 – Arithmetic average height of plants and the length of roots, their errors and variance for each sample

Variant	Factor	Dispersion, $\sigma^2$	Average, $\bar{x} \pm m$	<i>t</i> -criterion
Control (baby purified water)	Height of stem, cm	2	$21,2 \pm 0,45$	-
	Length of roots, cm	13,2	$23,1 \pm 1,15$	-
Source	Height of stem, cm	6,03	$13,8 \pm 0,6$	9,8
	Length of roots, cm	0,72	$7,75 \pm 0,07$	13,3
Midstream	Height of stem, cm	3,9	$19,8 \pm 0,4$	2,3
	Length of roots, cm	10,9	$22,4 \pm 1,09$	0,44
Mouth	Height of stem, cm	15	$17 \pm 1,5$	2,7
	Length of roots, cm	10,2	$22 \pm 1,02$	0,7

The values of the *t*-criterion in the “Source” section significantly exceed  $t_{st}$ . This means that the growth processes in this area are inhibited, and water has the greatest toxic effect compared to other points of selection. The values of the *t*-criterion in the “Midstream” section are close to  $t_{st}$ , therefore, the results obtained differ from the control. This indicates that the growth processes in the test water are inhibited, and the water has toxic properties. The values of the *t*-criterion at the “Mouth” section are close to  $t_{st}$ , the result obtained differs from the control by the length of the roots and the height of

the stems. This indicates that the growth processes in the test water are inhibited, therefore, the water has toxic properties.

We calculate the average value of the phytotoxic effect the results of which are shown in table 2.

Table 2 - Phytotoxic effect on water from the effects of anthropogenic factors

Parameter	Value, %		
	Source	Midstream	Mouth
FE (height of stem)	34,9	19,81	19,81
FE (length of root)	66,45	4,76	4,76
FE (dry basis)	57,3	44,44	48,5
FE average	<b>52,88</b>	<b>23</b>	<b>24,36</b>

Thus, the processes of plant growth according to these three criteria are inhibited in the first case by 52.88% compared with the control, in the second case by 23%, and in the third by 24.36%. The calculation of the phytotoxic effect had shown that the greatest anthropogenic impact on the river is carried out on the territory of Bulganak pond. It occurs due to accidental wastewater discharges on sewers, which lead to the treatment facilities in the village of Bondarenkovo. An increased pH of water in this area: pH = 10 indicates this. The hydrogen index increases due to the large amount of ammonia entering the water, which negatively affects the hydrobionts that live in the Bulganak pond.

In “Midstream” the main source of pollution is municipal solid waste (MSW) and storm drain from the Zarechny garage cooperative. It can be noted that the representative of higher vegetation, the common reed (*Phragmites australis*), is a factor of reducing the phytotoxic effect of water at this monitoring point.

At the third monitoring point the main source of pollution is the storm drain from the Gorkovskii Bridge and the discharge of food waste from the wholesale and retail market, which reduce self-cleaning processes due to the large consumption of dissolved oxygen as a result of their decay.

The spectral index is a quantitative indicator that is calculated as a result of mathematical operations with different spectral ranges of remote sensing (channels). Most indices were derived empirically and associated with different biophysical parameters of vegetation (photosynthetic activity, moisture content, etc.). As a rule, to process remote sensing data and obtain a spectral index, it is necessary to adjust the data in order to exclude the influence of the atmosphere and brightness. In this study we used the NDVI (Normalized Difference Vegetation Index) vegetation index, which has a range of values from -1 to 1. Values from 0.2 to 0.8 are usually characteristic

of vegetation. Using Landsat data from the EarthExplorer service, the Vegetation Index was calculated for the water area of the Kerch Strait and the Bulganak River (Fig. 1).

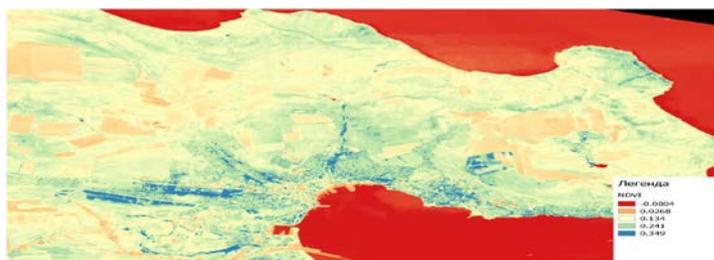


Figure 1 - Map for calculating the NDVI index

In the area of the Kerch Strait the vegetation index is  $-0.08$ . This indicates that biological pollution is not observed, and all processes occur naturally. In turn, on the Bulganak riverbed the index has a value of  $0.35$ , that is the maximum value of the index throughout the city of Kerch. Consequently, the bed of the small Bulganak river is subjected to eutrophication, that leads to an excess of organic matter, aerobic reduction of which causes a decrease in oxygen concentration due to anthropogenic impact and low rainfall.

**Conclusion.** According to Art. 65 p.10 of the Water Code of the Russian Federation, a water protection zone has not been established for this water body due to the fact that the mouth of the river is in a closed collector, but the installation of protective strips on the source territory will significantly improve the ecological state of the entire river [2]. The urgent need is to strengthen the protection of small rivers from pollution, clogging and depletion and the rational use of their water resources, as well as tighter control by the regulatory authorities and the management of the wholesale and retail market, the reconstruction of wastewater treatment plants and sewers leading to them all these can positively effect on condition of the Bulganak river.

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**Аннотация.** В статье рассматривается современное экологическое состояние малой реки Булганак города Керчи, и ее влияние на акваторию Керченского пролива. Приведен анализ проб, отобранных в октябре 2018 года, методом биоиндикации, а также спутниковые снимки Landsat с сервиса EarthExplorer. Предложены мероприятия по улучшению качества воды в реке и уменьшению воздействия на акваторию Керченского пролива.

**Ключевые слова:** экологическое состояние, малая река, мониторинг, акватория, антропогенное воздействие.

**Annotation.** The article deals with the current ecological state of the small river Bulganak in Kerch, and its impact on the waters of the Kerch Strait. The analysis of samples taken in October 2018 by the bioindication method, as well as satellite images of Landsat from the EarthExplorer service is presented. Measures are proposed to improve the quality of water in the river and reduce the impact on the waters of the Kerch Strait.

**Key words:** Ecological state, small river, monitoring, water area, anthropogenic impact.

UDC 520.1

## LIGHT POLLUTION. SKY BACKGROUND AND LIGHT

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**Introduction.** It just so happened that in the countries of the former USSR the vast majority of astronomy lovers live in large cities or their immediate suburbs. And it is quite natural that any newly-made owner of the telescope will try to see galaxies or emission nebulae in his instrument, making observations from the balcony or in the nearest courtyard. Alas, the weak nebulae are inaccessible to the urban observer, and no matter how large and expensive the telescope was used. The reason for this is urban exposure or, as it is also called, light pollution [1].

**The main part.** In order to assess the extent of this phenomenon and understand where to go for observation, let's try to imagine an observer away from city lights. Unlike a city dweller, such an observer will see not a red sky with several bright stars, but a huge black dome, dotted with a huge number of stars. But is it really black sky away from civilization? If you look at the starry sky through a telescope at low magnifications, you can see that the sky is actually noticeably brighter than the blackness outside the field of view. Even in the most remote high-altitude astronomical observatories, the same amount of light comes from every angular second as from a star with a brightness of 23 m. At first glance, this is very little. But from a square minute, light will come, as if from a star of 14 stars. magnitude, and with a square degree as from a star with a brightness of 5.2 m. If we take into account that the surface brightness of a number of nebulae and galaxies is comparable to this value, it becomes clear that this is not so small. It may be surprising that we can generally see objects whose brightness is lower than the brightness of the background of the night sky. But there is no reason to be surprised. The fact is that the light from the nebula mixes with the light from the night sky and the total brightness will still be higher.

Where does the background of the night sky come from? It turns out that the sky is not black even in space. The fact is that wherever we look, on even the smallest patch of sky there are separate stars and distant galaxies. They are very weak, but when combined, they give a uniform, albeit very weak glow. Also in the solar system there is an innumerable number of individual chickens and dust particles, on which the light of the Sun and stars is scattered. The light of distant stars and diffused sunlight provide about half the contribution to the background of the night, unlit sky. The second half of the sky background is provided by the earthly atmosphere. The day sky is blue because air molecules scatter the sun's rays. The same thing happens with the light of stars, as a result of which part of the light from them is smeared throughout the sky providing additional radiance. But that is not all. In the upper atmosphere there is an extremely rarefied gas, in the atoms of which, under the influence of sunlight, electrons move to higher orbits, and at night, the spontaneous return of electrons to ordinary orbits leads to additional emission lines [2].

Studies of the emission spectrum of the night sky showed that the greenest line with a wavelength of 555.7 nm is the brightest. oxygen emissions (forbidden), as well as red lines with wavelengths of 630nm, 636.3nm and 639.2nm. Contribute to the general background and radiation of the line of OH hydroxyl molecule with a wavelength of 656 nm, as well as a doublet of sodium lines.

The amount of light expressed in stellar magnitudes from one second of a second turned out to be a really convenient quantity for studying the quality of the sky. The shutter speed directly depends on this value when shooting the starry sky (increasing the background by one magnitude allows you to increase the shutter speed 2.5 times) and the ability to observe faint objects. It turned out that the background of the night sky in the same area varies depending on the direction, time of day and year, the state of the atmosphere, the presence of the moon and bright planets.

**Conclusion.** Studying the brightness of the sky background is one of the key characteristics of the astronomical climate. After all, the lower the sky background, the weaker the objects can be observed. For example, a number of dim extended diffuse nebulae become available for observation only when the sky background is below 21.5m. But if the sky background is brighter than 21m, then it becomes difficult to observe large galaxies located flat to us (for example, M33 or M101). When the brightness of the sky background is above 20.5m, most of the galaxies, the Crab nebula, become inaccessible. But if the sky background is brighter than 19.5m, only open clusters and compact planetary nebulae are available for observation.

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**Аннотация.** В статье рассматривается проблема засветки ночного неба.

**Ключевые слова:** засвечивание ночного неба, световое загрязнение, астрономические наблюдения, яркость, фон неба.

**Annotation.** The article deals with the problem of the night sky exposure.

**Key words:** night sky illumination, light pollution, astronomical observations, brightness, sky background.

UDC 535.3

**BENEFITS OF REMOTE SENSING PLANET EARTH**

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**Introduction.** What is Earth Remote Sensing or Earth Remote Sensing?

This, in essence, is observation of the Earth’s surface using space means equipped with various types of shooting equipment. Remote sensing spacecraft are used to study the Earth’s natural resources and solve meteorological problems. In addition, remote sensing is also used in agriculture, in geodesy, cartography, monitoring of the surface of the earth and ocean, as well as atmospheric layers. It is clear that remote sensing of the Earth is also used in the military field. Obviously, shooting from space (both photo and video shooting) is used for reconnaissance, monitoring the movement of troops and equipment, early warning of missile launch, which is a very important function [1].

**The main part.** A very serious area is the monitoring of compliance with obligations under various disarmament agreements. Here, remote sensing of the Earth from outer space using spacecraft plays a very important role. The operating range of wavelengths received by the survey equipment is from fractions of a micrometer (visible optical radiation) to meters (radio waves).

Sensing methods can be:

- passive – using natural reflected or secondary thermal radiation of objects on the Earth’s surface due to solar activity,
- active – using stimulated emission from objects initiated by an artificial source of directional action.

Remote sensing data obtained from a spacecraft (SC) are characterized by a high degree of dependence on the transparency of the atmosphere.

Therefore, spacecraft uses multichannel equipment of passive and active types that record electromagnetic radiation in various ranges. Remote sensing data provide the required quality of basic information for GIS.

Geographic information systems (GIS) are designed to collect, store, process, access, analyze, interpret and graphically visualize spatial data.

In the modern information society, GIS is increasingly used, because it is the most convenient tool for solving many practical, scientific and educational problems associated with the use of geographical information.

The Russian space remote sensing system is designed to provide information for solving a wide range of problems in the interests of various spheres of the state’s economic activity [2].

The main advantages of remote sensing are the high speed of obtaining data on large volumes of the atmosphere (or large areas of the earth’s

surface), as well as the ability to obtain information about objects that are practically inaccessible to research in other ways. With traditional meteorological measurements in the upper atmosphere, carried out using balloons, sophisticated remote sensing methods are systematically applied.

**Conclusion.** Remote sensing is quite expensive, especially space. Despite this, a comparative analysis of the costs and the results obtained proves the high cost-effectiveness of sounding. In addition, the use of sounding data, in particular meteorological satellites, ground and airborne radar systems, saved thousands of human lives by preventing natural disasters and avoiding dangerous meteorological phenomena. Therefore, research, experimental, design and operational activities in the field of remote sensing, which is intensively developing in the leading countries of the world, is fully justified.

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**Аннотация.** В данной статье рассматриваются преимущества дистанционного зондирования планеты Земля. Изложены основные причины применения ГИС.

**Ключевые слова.** Дистанционное зондирование, картография, мониторинг, геодезия, диапазон длин волн.

**Annotation.** This article discusses the benefits of remote sensing of the planet Earth. The main reasons of GIS application is stated.

**Key words.** Remote sensing, cartography, monitoring, geodesy, wavelength range.

UDC 629

## **BIODEGRADABLE PLASTIC. PRODUCTION TECHNOLOGY AND BASIC PROPERTIES**

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**Introduction.** Modern technology allows to create objects that are not subject to time. They are strong and durable. For example, plastic, the most

popular material on the planet, forms a significant amount of non-recyclable waste [2]. The decomposition time of one ordinary plastic bottle is about 400 years. Such features have a negative effect – after all, what has already been produced does not disappear, and production volumes continue to grow. The rate of increase in the share of plastics in garbage is increasing by about 10-12% per year in each country.

**The methods of research.** Before undertaking any research in any subject areas one must be sure about the intended purpose of the research. This purpose determines what type of research work is going to undertake. The purpose of our article is to analyze the most perspective way of using and production of biodegradable plastic, as one of the ways to improve the environmental situation. That's why our research is exploratory one.-This type of research may generate any novel idea in the domain of knowledge. It is primarily done for the purpose of finding anything new in ecology.

**Results.** The main disadvantage of plastic materials is their inability to self-utilize in the natural environment and environmental damage to the population [1]. However, there are no harmless ways to destroy such waste. The standard methods for recycling - incineration and landfill - do not solve the problem.

When burned, toxic gases (about 210 of them) are released into the atmosphere, poisoning living organisms and destroying the ozone screen. As a result, the risk of cancer is increasing. The rate of development of the greenhouse effect from burnt packages is 40 times higher than from thermal power plants. Landfill also does not solve the problem, as it is hidden from view, but not disposed of. Innovative ways of solving this problem are required [3].

For more than 20 years, scientists in America, China, Italy, and other countries have been trying to create biodegradable plastic that can decompose naturally, without harming the environment. Chemists have found that polymers made using plant materials are capable of self-degradation [2]. Biodegradable plastics are those that can be degraded by microbial action to produce natural end products, like water and carbon dioxide, in a reasonable period of time. The time needed to decompose completely depends on the material, environmental conditions such as temperature and moisture, and location of decomposition according to Biodegradable Products Institute [5, www]. The following kinds of biobased polyesters are:

- polylactide acid (PLA);
- polyhydroxyalkanoate (PHA).

PLA is a material which has been around for tens of years. “Until recently no major producer of PLA existed until they were funded by mega corporations to come into the marketplace to replace synthetic plastic” [4, www]. BioSphere Plastic has been asked is PLA biodegradable [4].

PHA is produced naturally by means of bacteria and Genetically Modified Organisms (GMO) plants. But there are plans to try production from food waste. Polyhydroxybutyrate or PHB is a kind of PHA that is used as well. “PHAs are expensive to make as only limited quantities can be produced from bacteria. It can be completely compostable in environments that are rich in microbes and fungi, especially soil. These microbes breakdown the PHA with the help of enzymes” [5, www].

The concentration of microbes in the environment influence on the time necessary to degrade it. According to Bio Based Press PHA takes two months to decompose in backyards. In marine waters the rate of decomposition is much slower where less than 50% is broken down after six months. “PHA passed the ASTM D7081 test by showing 30% decomposition in six months” [5, www].

The development of degradable plastic is considered the most promising industry in the struggle for environmental well-being. As a result, material is produced that is accessible to natural destructors - bacteriological organisms that decompose polymers. However, this option of plastic has a minus - low shelf life and high hydrophilic properties (moisture absorption).

Currently, plastic based on biopolymer has been created. Unlike synthetic plastics, it is made from components that exist in nature. This means there are bacteria that feed on it and degrade it (pict. 1).

There are no special stages categorically different from the production of ordinary polymers. The principle - to melt, stretch, shape - is preserved. Most biopolymers are produced in two stages.



Picture 1 – Decomposition of plastic into biopolymers

Source: [https://greenliving.lovetoknow.com/Type\\_of\\_Biodegradable\\_Plastic](https://greenliving.lovetoknow.com/Type_of_Biodegradable_Plastic)

At the first, a polymer is synthesized from natural components. Organic raw materials are used, which are obtained from renewable sources or daily waste, for example, bananas, pulp, legumes, polysaccharides, soybean oil or potato starch. These materials can be destroyed by microorganisms.

In a second step, a synthetic component is added to the resulting feed. During the second stage, the manufacturer can change the amount of the chemical component to obtain the desired properties [3]. As a result, the molecules of the natural polymer and synthetic bind alternately.

The new polymer has many supporters and opponents. The main advantage of the material is the use of biodegradable plastic, without violating environmental requirements.

The main disadvantages are expensive raw materials, chemical additives and the high cost of the process. As practice shows, biodegradable materials to accelerate the decomposition process also require the creation of special conditions: maintaining high temperature and humidity in the environment; access to sufficient oxygen; the presence of special bacteria [1]. Otherwise, the decomposition of biopolymers is significantly slowed down. To speed up disposal, additional use of special bacteria that decompose plastic is necessary. Hydrobiodegradable bags must be protected from UV rays, they do not have sufficient strength.

Biodegradable polymers are most prevalent in the manufacture of packaging for food and waste collection, disposable plates, glasses, implants in medicine, bags in supermarkets (pict. 2).



Picture 2 – Application of biodegradable plastic

Source: [https://greenliving.lovetoknow.com/Type\\_of\\_Biodegradable\\_Plastic](https://greenliving.lovetoknow.com/Type_of_Biodegradable_Plastic)

The process of transformation and disposal of biodegradable plastic allows you to create a wide range of objects, for example: hard objects of small thickness (trays, trays); foam sheets that can be cut to desired shapes and sizes; foam fillers for disposable packaging, adaptable to various shapes.

Based on this, the **conclusion** suggests itself that biopolymers are the future that will save humanity from global catastrophes associated with landfills and toxic gases. Using the forces of nature to destroy garbage is the only right way to avoid harming humans or the environment. “New types of plastics have been produced in recent years to address the plastic pollution problem, by trying to shorten the time needed to degrade them, especially in natural conditions” [5, www].

The search for suitable technologies and components is still ongoing, but now you can choose a material that is not life-threatening.

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**Аннотация.** В данной статье рассматривается технология использования и производства биоразлагаемого пластика, как один из способов улучшения экологической обстановки. Благодаря этому изобретению можно значительно снизить ущерб человека природе и добиться значительного успеха не только в оздоровлении планеты, но также и в определённых областях науки. Рассматриваются преимущества данного пластика, процесс его получения и утилизации.

**Ключевые слова:** биоразлагаемый пластик, полимеры, разложение, утилизация, сырьё.

**Annotation.** This article discusses the technology of use and production of biodegradable plastic, as one of the ways to improve the environmental situation. Thanks to this invention, it is possible to significantly reduce human damage to nature and to achieve significant success not only in the healing of the planet, but also in certain areas of science. The advantages of this plastic, the process of its receipt and disposal are considered.

**Key words:** biodegradable plastic, polymers, decomposition, recycling, raw materials.

UDC 523.98

## SOLAR FLARES AND THEIR IMPACT ON HUMANS

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**Introduction.** Probably, each of us at least once in my life heard complaints from our loved ones about feeling unwell due to outbreaks in the sun. So how do solar flares arise, what is their nature and mechanism of influence on human health.

A solar flare is an explosive process of energy release (light, heat, and kinetic) in the atmosphere of the sun. One way or another, flares cover all layers of the solar atmosphere: the photosphere, chromosphere, and the corona of the Sun. Usually they occur in the places of interaction of sunspots of opposite magnetic polarity, and "more precisely near the neutral line of the magnetic field separating the regions of northern and southern polarity" [2, p. 265].

**Main part.** The main problem to be researched in this article: how and why does a solar flare occur? Like any other star, the Sun is a huge gas ball. This ball rotates around its axis, but does it differently from our planet or other solid body. The rotation speed of different parts of this star is different. The poles move slower and the equator faster. As a result, the magnetic field of the Sun, together with the plasma, is twisted in a special way and is amplified to such an extent that it begins to rise to its surface. In these places, activity increases and flashes appear.

The energy of rotation of the Sun can turn into magnetic energy. In places where too much of this energy is released, flashes occur. For visualization, you can imagine an ordinary light bulb. If the mains voltage rises excessively, the bulb will burn out.

From the moment the solar flare begins, the radiation reaches the surface of the Earth within 8 minutes, after which powerfully charged particles are directed towards our planet. "Then, within a three-day period, plasma clouds reach the Earth" [1, p. 137]. A peculiar blast wave collides with our planet and causes magnetic storms. The duration of each flash usually does not exceed several minutes, but this time and the power of the energy emission are enough to

"The flash energy is determined in the visible range of electromagnetic waves by the product of the glow area in the line of hydrogen emission, characterizing the heating of the lower chromosphere, by the brightness of this glow, associated with the power of the source. to influence the state of the Earth and the well-being of earthlings" [3, p.13].

Let's consider the most pronounced effect of solar activity on the inhabitants of our home planet. Solar flares have an adverse effect on the human cardiovascular system. For this reason, the number of heart attacks and strokes increases during them. In people suffering from any kind of chronic diseases, exacerbations sometimes occur during outbreaks. And those who are completely healthy, sometimes there is causeless fatigue, apathy, loss of strength.

It has been established that during flares on the Sun, people's attention worsens and the rate of reaction to external stimuli decreases. For this reason, at such moments the number of traffic accidents increases. In addition, during these periods the number of industrial accidents increases, the cause of which is the human factor.

But what is the secret of the impact of outbreaks on humans? Does electromagnetic radiation reaching the planet have this detrimental effect on humans? Not really. As a result of outbreaks on Earth, the following reaction is observed:

1. Infrasound, which occurs in high latitudes, in the regions of the northern lights;

2. Micropulsations of our planet, which are short-period changes in the Earth's magnetic field, it is they that negatively affect the functioning of the human body;

3. As a result of flashes in the sun, the intensity of ultraviolet radiation coming to the surface of our planet changes.

**Conclusion.** So, as a result of such reactions of nature to flashes in the sun, biorhythms of not only humans, but also all living things on Earth change. Fortunately, scientists are able to predict solar flares, the frequency of which is due to eleven-year cycles of solar activity. What can be done to protect yourself from the harmful effects of a solar flare? It is necessary to carefully take care of health during solar flares, not to overwork, protecting yourself as much as possible from potentially dangerous stressful situations.

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**Аннотация.** Каждый из нас не раз сталкивался с жалобами близких, а может и с собственным неудовлетворительным самочувствием по причине солнечных вспышек. Что такое солнечные вспышки? Чтобы ответить на вопрос о том, как влияют они на человека, необходимо вначале разобраться с причинами, обуславливающими их возникновение, а также выяснить механизм их протекания. Эти вопросы, а также многие другие, будут рассмотрены в этой работе.

**Ключевые слова:** Солнечная вспышка, Солнце, электромагнитное излучение, солнечная активность, здоровье.

**Annotation.** Each of us has often come across complaints from relatives, and perhaps our own unsatisfactory state of health due to solar

flares. What are solar flares? To answer the question of how they affect a person, you must first deal with the causes of their occurrence, as well as find out the mechanism of their course. These issues, as well as many others, will be considered in this work.

**Keywords:** solar flare, the Sun, electromagnetic radiation, solar activity, health.

UDC 523.64

## COMETS AND THEIR SIGNIFICANCE IN THE STUDY OF THE UNIVERSE

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**Introduction.** Comets are bodies of the solar system that “look like foggy objects, usually with a light bunch-core in the center and tail” [2, p. 122]. To understand the usefulness of the study of comets for the study of the Universe, you must first delve into their structure. Given the “shedding” of material each time a comet orbits closely to the Sun, a comet’s lifespan may only be thousands of years – relatively small number when compared to the lifespan of the Solar System. “Thus scientists have concluded that if comets are still present in the Solar System today, then there must be a nursery of comets somewhere in the Solar System, otherwise all of the comets would have run the course of their lives long ago. The comet contains a nucleus, a coma and a tail. Consider each item in detail” [3, www].

**Main part.** “Some comets have highly elliptical orbits that bring them relatively close to the Sun. As these comets near the Sun the ices found within them melt and brilliant features are formed” [3, www]. The main area that the composition of the comet includes is the nucleus. It represents the solid part of a given object in which all its mass is localized. Modern technology does not allow to observe it with a telescope due to luminous matter. The most common model says that a mixture of ice and gases alternating with layers of dust is concentrated in the core. They evaporate as the body heats up and form dust clouds.

A coma surrounds the core and is represented by a foggy shell of a light type, shaped like a bowl. It is also dominated by gas and dust elements. The length is traditionally equal to from 100 thousand to 1.4 million km.

The tail is a luminous strip, which traditionally has a direction in the direction opposite to the Sun. In fact, the tail is made up of particles of dust and gas that reflect the light of our sun, which is why we can observe comets.

Comets are a kind of “time capsule”. Most of them formed in the early days of our system in a cloud of dust and gas around the sun. The bulk of the source material formed the planets, and only a small residue, especially in the outer regions, ended up in the bodies of space wanderers.

Since comets spend most of their time in the cold depths of space far from the Sun, their bodies are relatively well preserved. Thus, most comets can give scientists a unique chance to find out about the conditions of the young solar system even before the formation of planets.

Comets are also considered as possible carriers of primary life forms. The problem of the emergence of life on planets is associated, in particular, with the transport of matter inside and outside the solar system, in which comets play a key role.

The key objects that can help in the study of the Universe are asteroids, comets, and other relatively small objects. As detectives questioning eyewitness accounts, scientists painstakingly study comets and other objects to understand our origin, try to understand as much as possible about the times when “countless meteors and asteroids melted on planets, burned on the Sun, broke out of Neptune’s orbit, or collided with each other breaking into smaller bodies” [1, p.174]. From distant ice planets to asteroids that marked the end of the dinosaur era, every cosmic stone contains clues about the epic events that shaped the solar system in the form in which we know it today, shaped life on Earth.

After sunset, under the right conditions, you can notice the scattered sunlight in the plane of the ecliptic, in the sky, where the orbits of the planets. This is due to the fact that sunlight is scattered by the dust left from collisions of small bodies such as comets and asteroids. Scientists call this phenomenon “zodiacal light” and this indicates that our solar system is still active. Zodiacal dust around other stars indicates that they can also support active planetary systems.

Dust from small bodies played an important role on our planet, in particular. About 100 tons of meteorite material and dust fall to Earth daily. Some of them come from comets, activity directly played a role in the evolution of the Earth. When comets approach the Sun and experience its heat, the gases inside the comet burst out and carry away dusty material from the comet, including the ingredients necessary to shape life. So, the NASA Stardust spacecraft during the passage of Comet Comet 81P / Wild discovered that cometary dust contains amino acids, which are the building blocks of life.

Comets also affect the movement of planets today. As Jupiter's gravity continues to throw comets beyond the limits of the solar system, it gradually

moves toward the sun. At the same time, “Neptune, on the contrary, pushes comets inward and, in turn, also receives a small impulse. According to these processes, Uranus and Saturn also move very slowly in the direction from the Sun” [4, p. 78].

**Conclusion.** So, we can say that the role of comets as “time capsules” in improving our knowledge of the origin of the Universe, as well as life itself, cannot be underestimated. Comets could play a key role in the evolution of the Earth and other planets of its group as a source of volatile elements and their compounds.

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**Аннотация.** Кометы, астероиды и другие мелкие тела содержат вещества, возраст которых примерно равен возрасту Солнечной системы. Если мы хотим знать, откуда мы пришли, мы должны изучить эти объекты. В то же время, по современным представлениям, сами кометы могли сыграть важную роль в эволюции Земли и других планет земной группы в качестве источника летучих элементов и их соединений (в первую очередь воды).

**Ключевые слова:** комета, Солнечная система, космос, зарождение Вселенной, формирование жизни.

**Annotation.** Comets, asteroids and other small bodies contain substances whose age is approximately equal to the age of the solar system. If we want to know where we came from, we must study these objects. At the same time, according to modern concepts, comets themselves could play an important role in the evolution of the Earth and other planets of the Earth group as a source of volatile elements and their compounds (primarily water).

**Keywords:** comet, Solar system, space, the birth of the Universe, the formation of life.

## SECTION 10: PSYCHOLOGY AND PEDAGOGY



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### MEANS OF FOREIGN LANGUAGE TEACHING IN THE CONTEX OF PROFESSIONAL TRAINING IN A TEACHER TRAINING COLLEGE

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**Introduction.** Innovative technologies have become an important factor determining the development of society and its place in modern civilization, penetrating into all spheres of human activity and creating a global educational space.

Innovative technologies, as a medium of existence, provide the new opportunities: accessibility and continuity of training, and the ability to design individual educational routes.

**Main part.** “The technocratic orientation of life, accompanied by decrease of spirituality and morality, ideals, high values, leads to one-sided human development, to a narrow, one-sided professional and activity orientation” [2, p. 117]. The introduction of innovative technologies in the educational process increases didactic opportunities, providing control, visibility and accessibility, which promote improving the level of teaching, for example, teaching a foreign language.

Foreign language proficiency is considered as an important factor of scientific, technical, socio-economic and cultural progress, a tool for comprehensive information exchange [2]. Every year, the country's needs in competent teachers are growing. They will have to be able to use foreign languages effectively for various types of communication.

Analysis of recent publications and research and identification of the unsolved part of the problem showed that various issues of professional formation were studied by domestic and foreign psychologists and teachers such as V.V. Kraevsky, L.G. Laptev, V.A. Slastenin, N.D. Levitov,

I.A. Zimnaya, A.K. Markova, L.A. Petrovskaya, and others. The use of innovative technologies in professional training was considered by E.L. Vartanova, A.V. Werkowski, M.I. Makeenko, D.A. Chuvashov, A.A. Aksahin, A.A. Vicen, J.V. Maksheev, N.B. Nazarova, L.O. Mokhov etc. Many studies are devoted to preparing future teachers for professional activities by means of a foreign language. The content of competence in using a foreign language and innovative technologies is groundbreaking because they are considered not as an independent goal, but as a means of solving the tasks in which they are used.

The relevance of this research is due to the absence of researches about introducing innovative technologies in the process of teaching a foreign language in a teacher training college. The purpose of the study is to determine the means of forming a foreign language communicative competence in the process of professional training in a teacher training college.

As part of the implementation of the state program of the Russian Federation "Development of education" projects aimed at creating conditions for systematic quality improvement and the possibility of organizing training, self-education, and building individual educational routes of training were approved [5]. The teacher becomes not only a carrier of knowledge, which he shares with the students, but also a guide around the world.

Today, innovative technologies are being introduced into the educational practice of teaching a foreign language. Every year there are more varieties of methods and forms of teaching using new technologies in the field of foreign language teaching. "They are not only separate technical means or systems for exchanging and transmitting information, by means of which the educational process is carried out, but also it is a complete system of teaching methods aimed at developing students' communicative competence, developing speech skills» [3, www].

The use of innovative technologies in education creates favorable conditions for the formation of foreign language communicative competence of future teachers. We consider the following ones to be the most productive: SMART technologies; teleconferences and video phones [6].

It is possible to model learning situations using the latest SMART technologies (blogs, websites, webinars, Twitter, video and audio podcasts) in the process of teaching foreign languages, which provide the formation of a communicative abilities or skills of foreign language communication from awareness of the ability to express an idea in another language to the possibility of solving communicative and cognitive tasks. The use of SMART technologies increases motivation to study, revealing the creative and intellectual potential of the individual. In the course of training, the most effective means of forming a communicative competence is considered to be the use of class blogs (the class blogs) – an asynchronous type of

communication that extends the time frame of the training course and allows you to take an active part in the process of foreign language communication.

Teleconferences and video phones provide two-way communication between the teacher and students. This allows simultaneous two-way transmission of video, audio, and graphic illustrations. In group classes, it is possible to project the image of monitor on a large screen using a liquid crystal or other projection device.

Thus, the main pedagogical goal of using innovative technologies in the process of teaching a foreign language is the development of students' communicative abilities. The active use of such technologies and telecommunications facilities in the college means the introduction of innovative processes, through which there are changes in various plans: changing the goals and content of curricula, forms and methods of training.

**Conclusions.** The use of modern technologies in education, such as SMART technologies, teleconferencing and video telephony, creates favorable conditions for the formation of foreign language communicative competence of future teachers.

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**Аннотация.** Рассмотрены инновационные технологий при обучении иностранному языку в педагогическом колледже. Цель статьи – определение средств формирования иноязычной коммуникативной

компетенции в процессе профессиональной подготовки в педагогическом колледже.

**Ключевые слова:** педагогический колледж, инновационные технологии, иностранный язык, SMART-технологии.

**Annotation.** The article considers the means of foreign language teaching in a pedagogical college. The purpose of this article is to substantiate the role of innovative technologies in the effective formation of foreign language communicative competence in the process of professional training.

**Key words:** pedagogical college, innovative technologies, foreign language, SMART-technologies.

UDC 374.3

## TECHNOLOGIES OF PATRIOTIC EDUCATION IN THE CONDITIONS OF BOARDING SCHOOLS

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**Introduction.** Many of the outstanding Russian public figures, teachers, and philosophers consider the ability to love their Homeland as one of the main value in the education of a patriot and citizen. Thus, the Russian philosopher Ivan Ilyin believed that the basis of patriotic education is "love for the spiritual identity of the native people" and predicted that the solution of the problems of "civil education of youth will become one of the most important milestones in the revival of Russia" [3, p. 56].

**Main part.** The philosopher Vladimir Soloviev wrote about the evolution of patriotism as love, first for relatives, and later – natural love for their country as "the highest benefit" [7]. V.A. Sukhomlinsky reasoned about the importance of educating love for a small Homeland, as the basis of patriotism, from early childhood [8].

In recent years, the Russian educational system has undergone significant changes, which affected various areas of educational activity. According to the new school curriculum, the Great Patriotic war in history is now studied in the 10th grade, taking into account that about 50% of children leave school after the 9th grade. At the moment, there is a growing generation that receiving incomplete secondary education will not know anything about the Second World War and its heroes, if the child is not told about it by

his/her parents. Today, there is no more important idea for Russia than patriotism. In order to become a patriot, do not have to be a hero, it is enough to love our country, know its history. First of all, patriotism is a state of mind, soul [1; 2; 4; 5].

The process of Patriotic education in a boarding school is difficult, but its result should be more noticeable than in a mass school, it is complicated by a number of psychophysiological features inherent in children with disabilities [9]. A huge role in the process of education and upbringing is played by parents, whose main motivation is not education or patriotism, but the preservation and improvement of their children's health. Therefore, the level of solving educational tasks in a boarding school will be different than in a mass one.

In the framework of Patriotic education, in honor of the 75<sup>th</sup> anniversary of Victory on the basis of general education there was a survey in SBEI CR "Livadia sanatorium boarding school" among pupils of 8-11 classes. 52 students were interviewed. There were the following questions: "What do we know about the great Patriotic War on the eve of the 75<sup>th</sup> anniversary of Victory?" The purpose of the survey was to determine the level of children's knowledge about our history, about the great Patriotic war, and to stimulate interest in reading literature about the Great Patriotic war.

The questionnaire consisted of 14 questions related to the events about the history of the Second World War, its heroes, and battles. In 10 questions, children had to choose 1 of 4 answers, and give a detailed answer to 4 questions. In total 52 respondents (high school students) took part in the survey.

Analyzing the answers to the first 10 questions, we got 80% correct answers. This is the result of five years of joint work of the entire teaching staff. The answers to the following 4 questions showed that:

- 100% of the respondents had relatives who participated in the Second World War. Children first learned information about them from their grandparents in early childhood. Unfortunately, 30% of the respondents couldn't get information, as their parents didn't know anything, and their grandparents are not alive.

- absolutely all participants consider it important to know their history, but only 30% of respondents themselves show interest, parents talk about this topic very rarely, often only on May 9.

- the children received about 80% of the information at the boarding school, in the course of history and literature lessons, from teachers during excursions and events in which they participated, as well as during watching movies and meeting interesting people.

**Conclusion.** Summing up the results of the survey, it should be noted that children understand the cruelty and tragedy of the war and feel pride for the Soviet people who defeated fascism. "They gave their lives for the future

of our country” [6, p. 289]. But the survey showed that the participants spoke very little about this topic at home. So it is necessary to involve parents in solving this issue, explaining them how important it is for the upbringing and formation of moral values of teenagers, since not all children have learned some topics of the Second World War well.

Therefore, based on the experience of work on Patriotic education in the city of Sevastopol and in conjunction with the Department of "Pedagogy and psychology of creative development" of the Humanitarian Pedagogical Institute FSAEI HE "Sevastopol State university" along with the masters of the course of training “Organization of work with young people” it is planned to develop a series of events devoted to the feats of the heroes of the Second World war, in which children can learn to be friends and value friendship, to be kind, honest, do not afraid of difficulties, go forward courageously, do not afraid to help each other and nature, the Fatherland. Thus, the main task of our country is to educate worthy citizens of our country.

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**Аннотация.** В докладе рассматриваются технологии патриотического воспитания школьников: выявлены пробелы в школьной образовательной программе, касающихся Великой Отечественной войны, уточнены особенности патриотического воспитания в школе-интернате, описаны цели, задачи, ход и результаты опроса по вопросам Великой Отечественной войны учащихся школ-интернатов 8-11 классов.

**Ключевые слова:** патриотическое воспитание, Великая Отечественная война, школа-интернат, молодежь.

**Annotation.** The report examines the technology of Patriotic education of schoolchildren: identified gaps in the school educational program in terms of coverage of the great Patriotic war, specified the specifics of Patriotic education in a boarding school, describes the purpose, objectives, progress and results of the survey on the great Patriotic war, boarding school students grades 8-11.

**Keywords:** patriotic education, boarding school, the Great Patriotic war, youth.

UDC 378.147

**PREREQUISITES OF EFFECTIVE FORMATION OF  
READINESS OF MARITIME UNIVERSITY GRADUATES FOR  
PROFESSION-ORIENTED FOREIGN LANGUAGE  
COMMUNICATION**

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Readiness for profession-oriented foreign language communication is one of the professionally significant components of the future professional activity of graduates of maritime universities, the high level of formation of which will contribute to their professional growth, increase of their competitiveness in the world labour market, will ensure effective interaction with other crew members aboard a foreign vessel, which in its turn, is one of the most important circumstances facilitating successful and high quality performing of professional duties. Therefore, it is necessary to highlight the prerequisites for the effective formation of readiness for profession-oriented foreign language communication, i.e. necessary conditions, interrelated media of the pedagogical process, contributing to the successful achievement of the planned results.

The prerequisites for its effective and successful formation involve taking into account the characteristics of the audience of profession-oriented foreign language communication of graduates of maritime universities, who may be other members of the ship’s crew, ship agents, representatives of port authorities, inspectors, supervisors and superintendents conducting various types of checks on board the ship, etc. on the one hand, as well as a qualitative analysis and selection of professional, popular scientific and technical literature both in print and in electronic form, in order to familiarize future specialists of maritime universities with the communicative side of forthcoming professional activities.

Prerequisites for the effective formation of profession-oriented foreign language communication also require students to have such skills as understanding responsibility for decisions made, teamwork skills, critical thinking, effective communication skills (possession of effective written and oral communication strategies in a foreign language in a professional environment ), the ability to comply with professional ethics, which are an integral part of both communicative and general professional competencies [1, p. 88].

Another group of prerequisites for the effective formation of profession-oriented foreign language communication is high motivation of students and a developed conative component. According to the point of view of S.L. Rubinstein, in order to increase the student’s interest in the process of educational and cognitive activity, it is necessary to make the tasks set during the educational activity not only “understandable, but also internally pleasant to him, so that they acquire significance and thus find a response and a reference point in his experience. The level of consciousness is essentially determined by the degree of personal significance for the student of that which is objectively and socially significant”[3, p. 81]. The formation of

motivational readiness of students for profession-oriented foreign language communication will be facilitated by the formed attitude to a foreign language as a professional value. It is necessary to demonstrate to the student how relevant and essential the knowledge and skills acquired by them will appear to be in their future professional activity, which can be forwarded to a large extent by the modeling of foreign language communication in the context of working situations of future professional activity. The use of various forms of conducting classes, as well as the creation of a favorable emotional atmosphere, can also be singled out as motivating incentives that promote the active participation of students in educational and cognitive activities.

The conditions that contribute to the effective formation of readiness for profession-oriented foreign language communication include the unity of educational goals and the presence of interdisciplinary connections between the areas of teaching a foreign language and specialized courses at all stages of the formation of readiness for professionally oriented foreign language communication, as well as the orientation of the content of the foreign language study on a modular course developed by the International Maritime Organization, using of practice oriented set of tasks, drills and assignments, which are focused on the creation of communicative situations in the context of future professional activity, the creation of a learning environment close to the context of the real professional activity of graduates of maritime universities, and the use of educational technologies that contribute to the integrated development of both universal and professional qualities of the future specialists of maritime universities. This condition ensures the effective formation of motivational and interactive components of the readiness of future specialists of maritime universities for profession-oriented foreign language communication.

The prerequisites for the effective formation of the readiness of future specialists of maritime universities for profession-oriented communication include the implementation of the stages of its formation in conjunction and based on the principle of logical sequence. It implies acquisition of course content in a certain order and in a consistent manner. Logical framework approach shall be pursued while organizing the content of the course in particular and educational process in general. One of the reasons for failures in forming readiness and willingness for profession-oriented foreign language communication is a violation of the sequence in the presentation of the material, as a result of which the student forms a knowledge system with broken relationships, based on which the student is not able to effectively solve practical problems, as performance of professional duties on shipboard with multilingual crew depends greatly on the graduates capability to communicate.

The last but not the least essential prerequisite to be mentioned is the use of innovative pedagogical technologies in the educational process, which can provide a combination of different types of activities of cadets [2]. Their employment contributes to activating students' professional activities, e.g.

- interactive technologies are deployed in communication process to facilitate future business communication of graduates of maritime universities, i.e. when applying for a job, receiving visitors on shipboard, consulting relevant management offices, carrying out business negotiations, etc,

- educational role-playing is indispensable in imitating various communication acts and situations that require the formation of the necessary professional qualities,

- project-based learning involving solving a specific problem as a result of self-activities initiates creative adaptation of acquired knowledge in future professional activities,

- computer technologies allow to adapt innovative information technologies to individual characteristics of cadets,

- integration technologies are based on intersubject communication and increase the general cultural and scientific potential of a specialist.

In conclusion, it is to note that the necessity to form effectively and successfully readiness of maritime university graduates for profession oriented communication fosters both scholars and experts of pedagogics investigate, focus on and give prominence to various didactic theories, methods and techniques which may facilitate its formation. Whichever technique, theory, method or concept is proposed for this purpose, its effectiveness depends to a large extent on the following of the above mentioned prerequisites.

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**Аннотация.** В данной статье анализируются предпосылки, которые способствуют эффективному формированию готовности будущих специалистов морских образовательных организаций высшего

образования к профессионально-ориентированной иноязычной коммуникации, которая в значительной степени способствует успешному выполнению профессиональных обязанностей будущими специалистами водного транспорта. Соблюдение приведенных предпосылок считается универсальным и не зависит от дидактических концепций, методов и приемов, используемых для формирования готовности к профессионально-ориентированной иноязычной коммуникации.

**Ключевые слова:** предпосылки, формирование, готовность, профессионально-ориентированная иноязычная коммуникация, выпускники морских вузов

**Annotation.** The manuscript analyses the prerequisites which facilitate the effective formation of readiness and willingness of maritime university graduates for profession-oriented foreign language communication, the latter stipulating to a large extent successful performing of professional duties of future specialists of water transport. Their following is considered to be universal and irrespective of didactic concepts, methods or techniques employed for forming of the readiness for profession-oriented foreign language communication.

**Key words:** prerequisites, formation, readiness, profession-oriented foreign language communication, maritime university graduates.

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## **INNOVATE PHYSICS TEACHING METHODS IN MODERN SCHOOL**

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Modern society poses a completely different task for a person than 10-15 years ago. Every two years, the amount of information doubles. It is difficult for even a well-trained student to enter the modern world, new thinking, new views on all the changes that are taking place around us are necessary. In the modern school, more attention has been paid not so much to the knowledge gained in the educational process, but to the process of acquiring knowledge. Only the one who established this or that pattern himself could find the cause of the phenomenon, the process have a greater chance to harmoniously enter the modern world.

Innovation (from the English, innovation - innovation, innovation) - these are changes within the pedagogical system that improve the course and results of the educational process.

Today, many teachers use modern technologies and innovative teaching methods at school to achieve learning outcomes. These methods include active and interactive forms.

To successfully implement innovative teaching methods, the teacher must be able to:

1. Perfectly master modern information knowledge, technologies and methods of their application.

2. Successfully solve their own life problems, showing initiative, independence and responsibility;

3. To see and understand the real life interests of their students;

4. Respect your students, their judgments and questions, even if they seem difficult and provocative at first glance, as well as their independent trials and mistakes;

5. Feel the problematic nature of the situations studied;

6. Associate the studied material with everyday life and the interests of students characteristic of their age;

7. To consolidate knowledge and skills in educational and extracurricular practice;

8. Plan a lesson using the whole variety of forms and methods of educational work, and, above all, all types of independent work (group and individual), dialogical and design-research methods;

9. Set goals and evaluate the degree of their achievement together with students;

10. Perfectly use the method "Creating a situation of success";

11. To draw on the past experiences of students for discussion, to create new experience and organize its discussion without undue investment of time;

12. Assess student achievement not only with a mark, but also with a meaningful description;

13. To evaluate the progress of the class as a whole and of individual students not only in the subject, but also in the development of certain vital qualities;

14. See gaps not only in knowledge, but also in readiness for life.

Every physics lesson, from my point of view, should contain an experiment. An experiment is the basis of physics as a science. Unfortunately, it is not always possible to put an experiment at every lesson due to the fact that there are many subjective and objective factors (no equipment or equipment worn out, no time, and much more). Innovative teaching methods come to the rescue.

Due to the combination of various forms of information transfer: sound, tactile, visual - the level of students' perception of material increases.

The use of innovative teaching methods allows not only to form a certain amount of knowledge, but also to teach how to perform educational actions, i.e. own the tools with which schoolchildren will acquire this knowledge, and the fixed ability to consciously and independently use it in practice.

The use of innovative teaching methods affects not only the successful mastery of the material, but also the attitude of students to the subject.

A lesson is no longer an act of transferring information from teacher to student, new relationships are formed in which the teacher and student act as partners in achieving one goal, each of which makes an individual contribution. The student experiences a sense of success.

The use of innovative teaching methods in physics lessons helps to increase the motivation for learning this subject in students.

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**Аннотация.** В статье рассматриваются инновационные методы обучения физики в школе.

**Ключевые слова:** инновация, знания, физика, обучение, инновационные технологии.

**Annotation.** The article considers innovate methods of teaching physics at school.

**Keywords:** innovation, knowledge, physics, teaching, innovative technology.

UDC 304.2

### **THE PROBLEM OF PROFESSIONAL ORIENTATION OF SCHOOLCHILDREN IN THE CONDITIONS OF ADDITIONAL EDUCATION IN ARTEK**

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**Introduction.** The main thing is not to make a mistake, choosing who to become? .... Yes, yes, the main thing is not to make a mistake. But how do not make a mistake? How can you help your child understand who to become? The school provides basic scientific knowledge that makes it possible to enter higher educational institutions, etc. But, how to help the child make the right choice in choosing that activity what he will do next. The problem of vocational guidance of a teacher is relevant at all times.

Quite often, education after school, the child determines the parents. "I know better", "Listen to me, I have lived my life", "Will you be a doctor, a lawyer ...", but what does the child himself want? What does he want to become? How and how is it possible to help?

**The main part.** During the entire time of schooling, children are immersed in various events, both inside the school life and outside of it, visiting sections, studios, and circles. Visiting children's camps.

One of these is the Artek Federal State Budgetary Educational Institution. The target settings of the Artek educational system are related to relevant human qualities of the 21st century formulated by UNESCO: The basis of the Artek educational system is the target orientation of the 2nd generation federal state standards declaring the priority of the competency-based educational model in comparison with the model based on the knowledge paradigm.

The new educational system "Artek" is formed taking into account the characteristics of the environment and the accumulated successful pedagogical experience [5].

This experience is associated with the creation and development of productive interpersonal relationships in joint activities.

The basis of "Artek pedagogy" are the following ideas: - "pedagogy of cooperation"; - organization of collective creative activity; - technology for creating a temporary children's team; - the unity of the healing and educational processes, adaptability, communication skills, creativity and curiosity, critical and systemic thinking, the ability to work with information and media, interpersonal interaction and cooperation, the ability to pose and solve problems, focus on self-development, social responsibility. All these points make it possible for the child to open up, immerse himself in various activities and receive answers to his exciting questions [4].

The mission of "Artek" is formulated on the basis of humanistic values of the development of human individuality, self-determination, self-expression, self-realization, personal growth, cooperation and civic activity. Artek is considered in three aspects [6]:

– as a valuable educational system,

- as an innovative platform of the Russian system education,
- as a social institution.

In accordance with this, the triune mission of Artek is determined.

The mission of “Artek” as an educational system is to create an innovative culture-oriented recreational and educational space where the child will receive knowledge about the world and about himself, embodied in the ability to act and interact, successful experience of intellectual and creative activity that will become an incentive for its further development.

Artek, as an innovative platform for Russian education, stands in the development and implementation of pedagogical technologies that allow to obtain qualitatively new educational results that meet modern challenges of Artek as a social institution in educating a generation of people with innovative settings that can bring the country to key global positions in science, culture, creativity, humane interpersonal relationships. "Artek" is designed to educate converters, figures, creators seeking self-realization for the good of the country and the world [6].

**Conclusion.** In our opinion, for effective professional self-determination and orientation of students, it is necessary to create conditions for the students to develop the personal experience necessary when they determine the directions of their further education, the scope and content of future professional activity [1; 3; 4].

The opportunity for a child to get trial skills in choosing a future profession is given by the studio, the circles of the children's center. The focus is very diverse: natural science, socio-pedagogical, technical, tourist and regional studies, art, physical education and sports.

Such an extensive range enables each student to try himself in one direction or another, to carry out professional tests, to learn new things in that direction that is closer to him [2]. During the shift, the student plunges into the chosen orientation and studies from easy to complex and at the end receives the result in the form of knowledge, experience and the product that he created with his own hands. Further, he can use the information received for further study and choice of a future profession.

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**Аннотация:** в данной статье описана структура работы дополнительного образования МДЦ «Артек», на базе которой проходят профессиональные пробы как элемента профессиональной ориентации школьников.

**Ключевые слова:** профессиональные пробы, выбор, цель, дополнительное образование.

**Annotation:** this article describes the structure of the work of continuing education at the Artek International Educational Center, on the basis of which professional tests are conducted as an element of vocational guidance for students.

**Key words:** professional tests, choice, goal, additional education.

UDC 159.99

## **FEATURES OF CREATIVITY IN ADOLESCENTS WITH DIFFERENT LEVELS OF SUBJECTIVE CONTROL**

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**Introduction.** Adolescence is contradictory in its manifestations and at the same time is unique due to the fact that during this period there is a development of human creativity components: creative thinking and creative imagination. It should be noted that teenagers differ in cognitive activity, the appearance of new motives for learning, which allows them to work creatively independently, intensively develop creative thinking, which affects all other cognitive processes and intelligence in general. During this age period, changes also occur in the development of self-consciousness, the activity of becoming a person, attempts to determine their attitude to the world and their place in it [1].

**Main part.** Creativity is a complex, multi-dimensional and uniform phenomenon, which is expressed in a wide variety of scientific approaches to the study of this phenomenon. Such outstanding figures of psychological studies as D.B. Bogoyavlenskaya, J. Guilford, A.M. Matyushkin, Ya.A. Ponomarev, K. Rogers, S.L. Rubinstein, R. Sternberg, E. Torrence,

B.M. Teplov, Z. Freud and others contributed to the creativity research. At present, there is considerable theoretical and experimental material that testifies to the role of the individual in the development of creativity and creative abilities. However, many questions of creativity development remain unsolved.

The level of subjective control or its components, internality and externality, are not individual personal features, but certain personal patterns, a complete system of personal peculiarities. Because of this, that they are expected to be interconnected with almost all other complex mental processes and psychological properties, among which is creativity [2].

As part of this work, an empirical study of creativity and the level of subjective control was conducted, in which 40 adolescents aged 13-14 years participated. As a hypothesis, it was suggested that there is a relationship between creativity in adolescents and the locus of control.

There is a certain relationship between the components of creativity and the external and internal locus of control. In the future, to confirm the hypothesis of the relationship between the level of subjective control and creativity, a correlation analysis was performed using the coefficient of correlation p-Spearman (see Table 1).

Table 1. – Correlation coefficients between the locus of control and the parameters of creativity according to the method of E. Torrens

Parameters	Externality	Internality
Fluency	-0,005	-0,026
Originality	-0,078	<b>0,312*</b>
Abstraction of the title	0,125	-0,198
Opposition to disassociation	<b>0,347*</b>	-0,193
Elaboration	-0,058	0,011
General point	0,011	-0,073

\* - the correlation is reliable at the level of 0,05

\*\* - the correlation is reliable at the level of 0,01

As for E. Torrence's test, it was found that internality is associated with originality, i.e. the desire for originality is more inherent in internals than externals (for the Spearman's  $p=0.312$ ). This can be explained by the fact that internals in their behavior are much more based on their internal assessments than on the reaction of others and therefore do not hesitate to be original ( $p=0.312$ ).

As for externals, they are more focused on the reaction of others and therefore more open to new or unusual information, and they have more developed opposition to disassociation, which is also reflected in the positive relationship of externality with this parameter (for p-Spearman= $0.347$ )

Relationship of the correlation with locus control could not be established according to S. Mednik's test that can indicate both the specifics of this test and an insufficiently large sample [4].

The hypothesis was also tested based on the results of E. Tunik's method (see Table

Table 2 – Correlation coefficients between the locus of control and the parameters of creativity according to the method of E. Tunik

Parameters	Externality	Internality
Tendency to risk	-0,117	0,359*
Curiosity	-0,011	-0,003
Complexity	0,176	-0,177
Imagination	0,201	-0,229
Total point	0,077	-0,078

\* - the correlation is reliable at the level of 0,05

\*\* - the correlation is reliable at the level of 0,01

The correlation analysis showed that internality is positively associated with risk tendency according to E. Tunik's method, i.e. the higher the internality of the subject, the higher this indicator is (at p-Spearman=**0,359**). This relationship can also be explained by the fact that internals care less about the opinion of others and therefore are not afraid to fail to meet other people's expectations, they rely more on their own strength and are more likely to take risks.

In general, we can say that there is a certain trend, which is that internals have higher creativity.

As for the gender-specific characteristics of adolescent creativity, it was found that the higher level of creativity in adolescent girls and the level of creativity grow with increasing age.

However, due to the small sampling size, the results have not yet received statistical confirmation, and therefore these aspects can be the subject of independent research.

**Conclusion.** Thus, the study does not solve all aspects of given problem. Prospects for further study of this topic may include: studying the features of creativity development in a wider age range; determining the dominant types of creativity (verbal, nonverbal, social, etc.) depending on personal characteristics; studying the ratio of creativity and locus of control in a larger sampling, since in our opinion, some of the relationships of these psychological properties can only be manifested in large samplings.

Practical significance of the research is in the possibility of applying the results obtained in the practice of developing creativity in the process of learning at school.

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**Аннотация:** в статье представлены результаты теоретического анализа о психологическом содержании понятия креативность и связи с интернальным и экстернальным локусом контроля в подростковом возрасте. Прикладное значение данной работы заключается в возможности применения полученных результатов в практике развития креативности в процессе обучения в школе.

**Ключевые слова:** компоненты креативности, локус контроля, интернальность, экстернальность, подростки.

Annotation. The article presents the results of theoretical analysis of the psychological content of the creativity concept and its connection with the internal and external locus of control in adolescence. The applied value of this work is the possibility of applying the results obtained in the practice of developing creativity in the process of learning at school.

**Keywords:** components of creativity, locus of control, internality, externality, teenagers.

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## ADAPTATION OF THE MILITARY TO EMERGENCY CONSCRIPTION

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**Introduction.** The problem of adaptation of military personnel to the conditions of military service has long been one of the areas of research in various fields of psychology. The special interest of military psychology in

this problem stems from the specificity and high social significance of people's activities to protect state interests and the country's security, based on the fact that the success of this activity for the most part depends on the moral and psychological state and psychological readiness of military personnel to effectively realize its goals and tasks. The study of the laws, psychological mechanisms and typology of the adaptation process, the features of its manifestation in various categories of military personnel was the subject of study by A.A. Aldasheva, A.N. Zhmyrikova, J.G. Senokosova, A.A. Kamysheva, V.V. Popkova, I.V. Soloviev, A.V. Bulgakova [1; 2].

**Materials and methods.** The purpose of the article is an empirical study of adaptation in the military.

The object of study is adaptation.

Subject of study – the military.

The hypothesis of the study: it is assumed that the level of adaptation of the military depends on the mental and their psychical stability.

Empirical methods: stating an experiment for which the following psycho-diagnostic tools were used: questionnaire «Forecast – 2» (V.Yu. Rybnikov); multilevel personality questionnaire (MLO) «Adaptability – 1» (A.G. Maklakov, S.V. Chermyanin); analysis of statistical data using the Spearman rank correlation coefficient.

The experimental base of the study: military unit 63876 during the 2019-2020 years. It was attended by 20 military. The average age of respondents is 20 years.

**Results.** According to the results of the «Forecast – 2» questionnaire (V. Yu. Rybnikov) you can see general dynamics of levels of neuro- psychical stress in the military:

Among military servicemen, the average level (50%) of neuro-psychical stability to prevail among the majority. This means that the military possessing by this level are neuropsychically stable. However, there is a likelihood of neuropsychic breakdowns in tense, extreme conditions.

There are also military personnel who have a high level (35%) of neuro-psychical stress. This indicates that in the military of this category neuro-psychical breakdowns are unlikely, there is a high level of behavioral regulation, high adequate self-esteem and a real perception of reality.

According to the results of the diagnostics on the «Forecast-2» questionnaire, military personnel were identified who have a low level (15%) of neuro- psychical stress. Soldiers with this level have a low one of behavioral regulation, a lack of adequate self-esteem and a real perception of reality. The high probability of neuro- psychical breakdowns prevails. In such cases, a consultation of a neuro-psychiatrist (neuro-pathologist, psychiatrist) is necessary.

According to the «Adaptability – 1» test, it can be distinguished that behavior servicemen, communicative potential, moral normativeness,

personal adaptive potential, asthenic reactions and conditions, psychotic reactions and conditions, maladaptation disorders are at an average level (from 4,75 to 5,25). This means that conscripts have an adequate self-esteem, an adequate perception of reality, an average level of communication skills, quick contact with others, non-conflict, and a well-developed orientation towards observance of generally accepted norms of behavior.

According to the hypothesis put forward, it was highlighted that there is a relationship between the level of adaptation and the level of neuro-psychical stress in military personnel.

To process the results of the study, the Spearman rank correlation coefficient was chosen.

A weak correlation between neuro-psychical stress and personal adaptive potential ( $r = 0,3$ ;  $p \leq 0,05$ ) was highlighted. This means that neuro-psychical stability will be high if there is a high personal adaptive potential of conscripts.

The military with high personal adaptive potential easily adapt to new conditions of activity, quickly «enter» the new team, and are quite easily and adequately oriented in the situation. As a rule, they are non-conflict, have high neuro- psychical and emotional stability. The functional state of the military personnel during the adaptation period remains within the normal range, and performance remains unchanged.

The second weak inverse correlation between neuro-psychical stress and psychotic reactions and conditions ( $r = -0,24$ ;  $p \leq 0,05$ ). This means that neuro-psychical stress will be high if there are low rates of psychotic reactions and conditions.

If the military personnel have low indicators of psychotic reactions and conditions, this means that they will not be adapted to military conscription. This group of military personnel will have impulsive reactions, attacks of uncontrollable anger, strong neuro-psychical stress, deterioration of interpersonal contacts, violation of moral and ethical orientation, excessive aggressiveness, suspicion.

Military personnel who have low rates of psychotic reactions and conditions will be at risk.

**Discussion and Conclusions.** After analyzing the results, we can conclude that the level of neuro-psychical stability depends on the level of adaptation of the military.

Thus, the hypothesis of scientific research has been partially proven.

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**Аннотация.** В статье представлены результаты эмпирического исследования взаимосвязи адаптации военнослужащих к срочной службе с разным уровнем нервно-психической устойчивости. Исходя из полученных данных, можно сделать вывод о следующих психологических взаимосвязях: тенденция к корреляции между нервно-психической устойчивостью и личностным адаптационным потенциалом военнослужащего срочной службы; обратная корреляционная связь между нервно-психической устойчивостью и психотическими реакциями и состояниями.

**Ключевые слова:** военнослужащий срочной службы; адаптация, нервно-психическая устойчивость, корреляция, личностный адаптационный потенциал.

**Annotation:** The article presents the results of an empirical study of the relationship between the adaptation of military personnel to military service with different levels of neuro-psychical stress. Based on the data obtained, it can be concluded about the following psychological relationships: the tendency to correlation between neuro-psychical stability and the personal adaptive potential of a member of the military service; inverse correlation between neuro-psychical resistance and psychotic reactions and conditions.

**Keywords:** the military; adaptation, neuro-psychical stability, correlation, personal adaptive potential.

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## **ACTIVITY OF A HEALTHY LIFESTYLE OF YOUTH**

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**Introduction.** Young people are a special social and age group that differs by age and their status in society: the transition from childhood and youth to social responsibility.

According to Rosstat, the number of young people in Russia according to statistics in 2016 is 31.4 million (14-30 years), which is 21.5% of the total population of the country [3].

In youth, the basic lifestyle habits are formed. It is youth that is the present, and in the future it is also the labor force of our state. By order of the Government of the Russian Federation No. 2403-r dated November 29, 2014, the Fundamentals of the state youth policy of the Russian Federation for the period until 2025 were approved, aimed at setting priorities for the formation of values of a healthy lifestyle, the implementation of projects in the field of sports, sports and recreation activities related to popularization of a healthy lifestyle, sports, as well as the creation of a positive lifestyle for young people leading a healthy lifestyle; assistance in the development of infrastructure for recreation and health of youth, the creation of conditions and the formation of motivation for a healthy lifestyle, which is undoubtedly one of the urgent and main priorities of the demographic policy of the Russian Federation [5]. That is why education, the formation of beliefs of a healthy lifestyle, conditioned reflexes of correct behavior are of great importance [1].

**Main part.** World Health Organization (WHO) experts say that human health is 50% dependent on a healthy lifestyle, so maintaining and promoting health is a top priority. Currently, motivation for a healthy lifestyle is especially relevant. The main components of a healthy lifestyle are: a balanced diet; optimal physical activity; hygiene measures; rejection of bad habits; infectious disease prevention; rehabilitation measures. The formation of a healthy lifestyle in the youth environment is associated with an ambiguous situation of the physical and spiritual state of youth in connection with the use of tobacco, alcohol, psychoactive substances, and adverse environmental conditions. According to the Rospotrebnadzor of Russia in statistics, smoking statistics look like this for more than 3 million adolescents: 0.5 million girls and 2.5 million young men [4]. Alcoholism is another problem of Russian teenagers, drug addiction is also quite common. All this can lead not only to the risk of wrinkles and the aging process of the skin, but also the appearance of serious diseases.

Some time ago, rigid diets were popular that did not give the desired effect, and eating unbalanced food without medical supervision led to negative consequences, receiving several acquired diseases in return for a beautiful figure.

However, we can confidently say that the vast majority of modern youth are thinking, smart, informed, purposeful people who lead an active lifestyle. Young people in their teens began to understand that in order to look good

you need to have a good sleep, eat balanced foods with a high content of vitamins and minerals, observing the daily routine, walking in the fresh air, as well as playing sports during which the production of endorphins, stimulating positive emotions. People who engage in physical activity and sports are less likely to suffer from a number of diseases, including heart disease and cancer. In addition, they often have a healthy body weight and tissue composition [6]. Physical activity for most young people is a base in their daily lives.

**Conclusion.** To lead a healthy lifestyle in the understanding of youth is to create the image of a successful, attractive and beautiful person, because health is an invaluable asset of all mankind. Thus, a healthy lifestyle is one, preservation and improvement of people's health, knowledge of the world, the disclosure of creative abilities.

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**Аннотация.** В докладе рассматриваются основные особенности здорового образа жизни для молодежи. Отмечается, что мотивация к здоровому образу жизни особенно актуальна. В статье перечислены основные составляющие здорового образа жизни.

**Ключевые слова:** здоровый образ жизни, употребление алкоголя и табака, правильное питание, физические упражнения.

**Annotation.** The main features of a healthy lifestyle for young people are discussed in the report. It is noted that a motivation for a healthy lifestyle is especially relevant. The main components of a healthy lifestyle are listed in the article.

**Keywords:** healthy lifestyle, alcohol and tobacco consumption, proper nutrition, exercise.

# FORMATION OF FUTURE NAVIGATOR'S INTERPERSONAL COMMUNICATIONS SKILLS IN THE CONTEXT OF ENGLISH LEARNING

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## **1 Introduction**

Every specialist is required to communicate with and interact with a wide range of people through the crew and master. «In connection with the development of scientific and technological progress and socio-economic changes in the country is constantly expanding the scope of communicative navigators: now they solve not only traditional issues (when dealing with the pilot, agent, etc.), they have to conduct radiotelephone negotiations of a medical nature, etc. For this reason, the content of training English language necessary to make appropriate adjustments» [9, p. 512]. The lack of the necessary number of specialists with the appropriate qualification level is the main problem a modern navigation.

The analysis of Federal State Educational Standard of Higher Education in the directions of training 26.05.05 – Navigation (specialist degree) was provided which showed that among the necessary skills are the following: ability to communicate orally and in writing in Russian and foreign languages to solve problems of interpersonal and intercultural interaction (GC-6) [5]; readiness for communication in Russian and foreign languages in oral and written forms to solve the problems of professional activity (GCP-2) [5].

The content of the pedagogical process should include innovative aspects of educational technologies [10, www].

The regulatory requirements for professional and personal training of specialists are growing accordingly with the rapid development of the international trade, increasing the overall level of communication competence. “It is known that students with the most developed communication skills have a greater chance of getting an invitation to a prestigious job before the end of their training period” [11, www]. These characteristics are considered as important criteria for their professionalism, as well as indicators of the quality of training of future navigators in higher education institutions.

### **1.1 Relevance of the research**

The relevance of this study is determined by the social demand of society for better training of navigators in universities, since the international trade is one of the main areas of future development. The most important interpersonal skills are stated to be developed organizational skills, i. e. ones of collective action.

## **1.2 Study of the problem**

Scientists A.R. Akhmadullin [1], V.V. Rubtsov [4], G.S. Tseitin [6], D. Knut [8], T.S. Bochkareva [2], S. Sonnentag [13], and others, were engaged in questions about important interpersonal skills of future specialists and their role in the professional development of a specialist. The skills of collective action were considered by V.A. Leont'ev [3].

The higher school is intended to provide certain conditions which provide the possibility of «transformation of personal and social goals into an effective internal incentive for professional and creative development of the future specialist, the development of an active professional position and creative style of activity» [10, www].

## **2 The aim of the research**

The purpose of this article is to identify the new pedagogical technologies that contribute to the efficiency of future navigator's interpersonal communications skills in the context of English learning. The object of our study is interpersonal communications skills and the subject of this one is characteristic of communicative skills indicators. In accordance with the goal, the following tasks were set:

- 1) to determine the role of communicative interaction in the future professional activity;
- 2) to consider innovative technologies in order to improve the level of students' professional communication skills.

## **3 Materials and methods**

To achieve the goal, we used of the requirements of Federal State Educational Standard of Higher Education in the directions of training 26.05.05 – Navigation (specialist degree) [5].

## **4 Results and discussion**

«Interpersonal communication is the process of face-to-face exchange of thoughts, ideas, feelings and emotions between two or more people. This includes both verbal and nonverbal elements of personal interaction» [7, www].

Among the main interpersonal communication skills are the skills of collective action, which affect the success of the entire ship's crew.

«Interpersonal skills are traits you rely on when you interact and communicate with others. They cover a variety of scenarios where communication and cooperation are essential» [7, www]. Interpersonal skills can include the following components: teamwork, motivation, flexibility, empathy, dependability, leadership, responsibility, active listening.

Navigator is a specialist in ship navigation, whose main task is to safely guide the ship along the necessary route. The navigator operates vessels, organizes management of water transport; performs maintenance and repair of ship power plants and mechanisms; ensures the safety of navigation, handling and placement of cargo; analyzes the efficiency of the vessel;

prevents environmental pollution. Professionally important qualities of a navigator are endurance, accuracy, care, sense of responsibility, organizational skills of the employee.

The highest level of development of the skill of collective action is coherence or coordination. When working well together, the navigators understand each other in half a word, in this case there is no need to waste time on unnecessary explanations. «Mutual understanding and collective action skills arise from the joint study of individual characteristics of training and qualities of each other, the same and simultaneous understanding of events» [12, www].

«In a work environment, strong interpersonal skills are an asset that can help future specialists navigate complexity, change and day-to-day tasks» [7, www]. For example, leadership is a key interpersonal skill that involves effective decision making. «Effective leaders incorporate many other interpersonal skills, like empathy and patience, to make decisions. The ability to work together as a team is extremely valuable in every workplace» [7, www].

Unity of views and mutual understanding of the team on all professional issues are the main components of the success of collective action skills formation. Factors such as collective thinking, collective will and the psychological climate play an important role in collective action skills forming.

Collective thinking is based on a common goal and a common tactical plan. The direction of everyone's thinking is united by a single goal in a single tactical direction. The collective will is presented in the unity of the collective in the process of overcoming obstacles. The psychological climate is as a general background against where thinking and will are especially manifested.

In the process of professional training of future navigators, it is necessary to develop communication skills and organizational ones. Future navigators should understand that whether they can successfully perform the tasks assigned to them depends on the psychological climate in the team.

New pedagogical technologies can contribute to the formation of collective skills of future ships crew.

Here are some of the best ways to teach these skills in the context of English learning: *Role-play, Group games, Introspection, Turn-talking, Films, Asking questions, Record and reflect.*

Teamwork involves many other interpersonal skills like communication, active listening, flexibility and responsibility.

«Group games are an interactive, engaging way to teach verbal and nonverbal communication, persuasion, collaboration and relationship-building skills. Through group games, students learn to efficiently pass information on to others» [14, www].

Working towards a specific goal as a group requires communication in the context of English learning. The following steps should be done :

1. Ask the team (the crew of any type of ship) to build, design or create something over a set period of time.
2. Observe their interactions as they work.
3. Ask the group what went well and what they could've done differently.
4. Share the observations with positive feedback for each individual on what they did well [14].

#### **4 Conclusion**

Interpersonal skills are considered to be ones required to effectively communicate, interact, and work with groups or individuals. Communicative skills can be defined as certain attributes or abilities that an executive should possess in order to fulfill specific tasks in an organization [7].

We determine the role of communicative interaction in the future professional activity:

- activity as an ability to make quick decisions;
- practicality of mind-ability to apply knowledge in any situation;
- self-control, self-criticism, self-assessment of the actions.

Good communicative skills are vital for any crew to succeed and achieve its objectives.

In the context of professional training of future navigators, it is necessary to develop communication skills and organizational ones. Future navigators should understand that whether they can successfully perform assigned tasks depends on the psychological climate in the team.

Monitoring the development of appropriate communication skills can significantly improve the quality of professional training and, as a result, the internal efficiency of future navigators.

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**Аннотация.** Автор рассматривает педагогические технологии, способствующие повышению эффективности формирования навыков межличностного общения будущего штурмана в рамках изучения английского языка. Объектом исследования являются навыки

межличностного общения, а предметом – факторы, влияющие на успешность формирования коммуникативных навыков будущих судоводителей.

**Ключевые слова:** судоводитель, английский язык, навыки коллективных действий, коллективное мышление и воля.

**Annotation.** The purpose of the article is to identify the new pedagogical technologies that contribute to the efficiency of future navigator's interpersonal communications skills in the context of English learning. The object of our study is interpersonal communications skills and the subject of this one is characteristic of communicative skills indicators.

**Keywords:** navigator, English learning, skills of collective action, collective thinking and the will.

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## **THEORETICAL ANALYSIS OF THE STRUCTURE OF COMMUNICATIVE COMPETENCE IN PSYCHOLOGY**

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**Introduction.** The study of the problem of communication in psychology is important, which helps to better understand the communicative process. Due to studies of communicative competence, practical psychologists are developing psychological tools for developing communicative competence.

**Materials and methods.** The purpose of the study is to analyze domestic and foreign authors who investigated the phenomenology of communicative competence.

If we turn to the statements of I.N. Gorelova, communicative competence is a unique set of tactics and strategies that is inherent in an individual or group of individuals.

From the opinion of G.A. Andreeva, communicative competence is perceived as an ability to orientate. G.S. Trofimova adds here the ability to navigate in various communication situations.

Communicative competence as a system of internal resources necessary to build an effective communicative action in a certain circle of situations of interpersonal interaction and as a communicative flexibility are considered by L.A. Petrovskaya and O.I. Muravyova.

From the works of Yu.N. Emelyanova, it becomes clear that communicative competence is the ability to communicate; human ability to interact verbally, not verbally or silently; integrative ability to interact productively with others, taking into account communicative opportunities - both their own and their interlocutor [2].

Studying foreign sources, we came to the following conclusion - communicative competence is understood as the ability to communicate verbally or in writing with a native speaker of the studied language in real life situations. The emphasis is on the transmission of meaning, and the type of presentation of information (more precisely, the clarity of language resources) is secondary to the meaning of the statement [6].

First used the concept of «communicative competence» A.A. Bodalev also interpreted as the ability to establish and maintain effective contacts with other people in the presence of internal resources (skills, knowledge, experience) [1].

In the definitions of communicative competence according to V.I. Zhukov, we are talking about the psychological aspect of the characteristics of a person as a person, which is revealed in his communication with people or «the ability to establish and maintain the necessary contacts with people». The author attaches great importance to the totality of knowledge, abilities and skills as part of communicative competence. It was they who determined the successful course of communicative processes in humans [3].

Having studied the work by I.N. Zotova we can concluded that communicative competence is a clearly defined complex education, which includes three components:

- emotionally motivational, formed by the need for positive contacts, the reasons for the development of competence, the meaning of “being a successful” partner of interaction, as well as the value of communication and goals;

- cognitive, which includes knowledge from the field of human relationships and special psychological knowledge acquired in the learning process, as well as meanings, the image of the other as a partner of interaction, socio-perceptual abilities, personality characteristics that form the communicative potential of a person;

- behavioral - as a special system of acceptable models of interpersonal relationships, as well as personal control of communicative behavior [4].

Thus, the following authors can be distinguished as leading specialists in the studied problems: M.V. Shinkoruk, T.E. Nalivaiko, S.V. Petrushin, Y.L. Kolomensky, G.O. Galich, I.N. Zotova, E.M. Alifanova, etc.

And now let's take a closer look at the structural components that make up communicative competence.

So, the first component is cognitive. This means that knowledge of a person about himself/herself, as a subject of communication, acquires the dominant value. Where a person realizes that he is unique, constantly changing. And, going beyond the framework of the familiar "Self-concept", he/she can open up additional possibilities. And as a result he/she develops subjective self-knowledge.

Based on the foregoing, we can summarize: the cognitive component in the structure of communicative competence must be understood as a system of knowledge about the communication process and the ability to adequately evaluate a communication partner.

The next communicative component is emotional. Comparison with affective is clearly traced in the works of Ya.L. Kolomensky. According to him, a demonstration of mutual understanding, empathy, perception, etc. is supposed.

Analyzing the work of E.M. Alifanova, it becomes obvious that this component includes empathy, emotional responsiveness, sensitivity to another, the ability to empathize and compassion, attention to the actions of partners.

The more the emotional component is developed, the more likely is the new emotional experience on the basis of strong experiences, which will differ significantly from the previous one. This means: the more developed and enriched the experience of an individual's communication, the more differentiated he is, depending on various forms of communication, the more correct will be the person's behavior in communication, and his perception,

Self-reliance is another important element of the emotional component. The characteristic features of the internal dynamics of self-consciousness, the structure and specificity of the relationship of the individual to his own "I" play a significant role in establishing interpersonal relationships, have a decisive influence on virtually all aspects of human behavior.

In addition to positive self-relationship, such a component as self-acceptance is of great importance, which W. Frankl proposed to consider as the equivalent of self-love.

The final in this study is the behavioral component.

According to S.V. Petrushin, who, in turn, supports G.O. Galich, the behavioral component lies in the technique of the productive use of various means of communication that are actually used in communicative situations.

Much has been said about the behavioral component in the works of Ya.L. Kolomensky. The author outlines communication skills there:

listening, emotionally experiencing, addressing messages, critical of one's own opinion, attracting the attention of the interlocutor, and others.

The predominantly behavioral component covers free possession of verbal and non-verbal means of social behavior. These include audio speech using numerous phonetic and non-verbal elements, as well as written speech and essentially non-verbal means (such as posture, gestures, arrangement, etc.).

In addition, in the behavioral component, the most important is such a way of behavior as self-disclosure. Openness should be like here and now, i.e. what a person feels or thinks at the moment. With self-disclosure, a person runs the risk of being himself, without a «mask», not striving to look better or worse than he is.

Another of the basic criteria for the development of a person's communicative competence is reflection, due to which a person has the opportunity to look at his position in accordance with the position and interests of the partner [5]. Reflection is the awareness by the acting individual of how he is perceived by the communication partner. Here we are already observing not just the knowledge or understanding of the other, but the knowledge of how the other understands me, the doubled process of mirror images of each other, a deep, logical interplay, the content of which is the reproduction of the partner's inner world, and in this inner world the turn is reflected in my inner world.

**Results.** In modern psychological science, communicative competence is considered as a system of internal resources that are necessary to create an effective communicative action in a certain circle of situations of interpersonal interaction.

Communicative competence includes 3 components:

- the cognitive component involves the expansion of knowledge about communicative competence;
- the emotional component involves the management of the emotional sphere in communication;
- behavioral – forms an effective communication strategy in interpersonal interaction.

**Discussion and Conclusions.** Despite existing research, the problem of communicative competence remains relevant in both domestic and foreign psychology. We observe a variety of approaches to the definition itself. What unites them is that under the communicative competence the authors interpret a complex organization, which includes the ability to adequately and fully feel and evaluate oneself and others, the ability to manage one's emotions, the acceptance and support of another person, cognition, social character, and human skills communication.

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**Аннотация.** В статье представлен анализ отечественных и зарубежных авторов, которые исследовали коммуникативную компетентность. В частности, исследована сама структура коммуникативной компетенции. Выделены и подробно рассмотрены ее основные компоненты.

**Ключевые слова:** коммуникативная компетентность, коммуникации, эмоционально-мотивационный, когнитивный и поведенческий компоненты.

**Annotation:** The article presents an analysis of domestic and foreign authors who investigated communicative competence. In particular, the structure of communicative competence is investigated. Its main components are considered and examined in detail.

**Keywords:** communicative competence, communication, emotional-motivational, cognitive and behavioral components.

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## SPECIFICITY OF VALUE ORIENTATIONS OF STUDENTS- FUTURE PSYCHOLOGISTS

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**Introduction.** In modern conditions, the rethinking of values and social changes in various spheres of human life, the problem of value orientations of the individual becomes especially relevant. They determine the focus on activity, determine the choice and fulfill the function of regulators of behavior.

The profession of psychologist requires a person to have certain personal qualities, the presence of a humanistic, altruistic orientation and the corresponding value orientations (M. Rokich, G. Allport, S. Schwartz, V.A. Yadov) [1; 2; 3]. Studying the specifics of the value orientations of psychology students will help determine the readiness for professional activity, focus on working with people, on the personal development of a student psychologist (B.G. Ananyev, K. Rogers, A.N. Leontyev).

The formation of value orientations is closely related to the development of the personality orientation. They are a mechanism of personal growth and self-development [4]. In this regard, the development of professionally significant value orientations of a student at the university stage is an important aspect of vocational training.

**Materials and methods.** The purpose of the work is a theoretical and experimental study of the specifics of value orientations in the student community.

The object is the phenomenology of value orientations in psychological science.

The subject is the specifics of value orientations among psychology students at different courses of study.

The following hypothesis was put forward: It is assumed that there are differences in the specifics of value orientations and personality orientations among psychology students at different courses of study.

Empirical methods: the test of Bass personality orientation and the M. Rokich test «Value Orientations»; statistical: a method of descriptive statistics, non-parametric U-Mann-Whitney criterion for comparing disconnected samples.

To prove the hypothesis and achieve the goal of the work, we conducted a stating experiment at the Sevastopol Institute of Economics and Humanities

(branch) of Federal Crimean University by V.I. Vernadsky during the 2019-2020 academic year.

It was attended by 16 students in the direction of training 37.03.01 Psychology in the social sphere of 1, 2 and 4 courses. The average age of respondents is 18,5 years old.

**Results.** The following hierarchy of value orientations among psychology students was presented in the group:

For students of all courses, health and love come first.

First-year students consider the value «Courage in upholding their opinion» to be the most important.

For 2<sup>nd</sup> year students, the values of responsibility, honesty and cheerfulness are important.

For 4 courses, the values of health and material security are almost equal in importance. The value of “development” is also important for them. This is due to the end of their professional development at the university and the beginning of a new stage of professional work.

Students of all courses equally reject the value of «Happiness of others». This is contrary to the chosen profession.

In the group «Values of professional self-realization and personal life», for all courses, the most significant are the values from the group «Personal life».

The group «Values of self-affirmation and acceptance of others» reveals a tendency to self-affirmation.

In the group of respondents according to B. Bass's methodology «Personality Orientation», there is a weakly expressed focus on others at all courses, the same focus on oneself (30-32 points), and the focus on business expressed in the first and fourth courses.

To process the results of the study, a nonparametric Mann-Whitney U-test was chosen.

According to the methodology for determining the orientation of B. Bass's personality, no significant differences were revealed. At all courses, there is a similarity in the orientation of the personality.

By the method of M. Rokich, the following significant differences in the courses were revealed:

Between I course and II course on the level of instrumental value orientation «Education» ( $U_{emp} = 2; p \leq 0,05$ ).

Based on the calculations, «Education» as an instrumental value is of greater importance for 2 courses.

Between II and IV courses in terms of the level of instrumental value orientation «Independence» ( $U_{emp} = 2,5; p \leq 0,05$ ).

The results obtained allow us to assert that for 4 year students the orientation towards independence is much more important than for 2. What may be due to the fact that 4 year students are at the end of their professional

path, have their own formed views, values, and do not want to depend on opinions others, neither from parents, nor from other external circumstances.

Between I and IV courses on the level of instrumental value orientations «Creativity», «Education», «Courage in upholding ones views» (Uemp. = 3;  $p \leq 0,05$ ).

According to the results of the mathematical analysis of the primary data, it can be argued that 1st year students are more creative than 4 years old and are not inclined to be educated, in particular, in upholding their opinions. Psychology students of 4 courses are not focused on upholding their views, which indicates a more mature personality. And first-year psychology students reject the «Parenting» value, which contradicts the basic qualities of a psychologist as a specialist whose work is connected with other people and involves establishing relationships with them.

Based on the results of the calculation, psychology students in the 4th year do not acquire the full range of humanistic values. A psychologist who does not have such value orientations cannot fully realize the goal of his profession. Because, as was revealed during the theoretical analysis of literature, a psychologist must be able to show deep interest in people and patience in communicating with them, respect for the rights of other people. And the formation of such a value hierarchy for a psychologist is the foundation of effective work.

**Discussion and Conclusions.** Thus, the hypothesis of scientific research has been partially proven. Such a psychological picture characterizes the value orientations of psychology students as directed towards themselves, their personal goals and the means to achieve them.

The data obtained allow to conclude that the orientation toward others, the values of acceptance, tolerance among psychology students is weakly expressed. What follows is the lack of education among students of value orientations important to the psychologist.

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**Аннотация.** В статье представлены результаты эмпирического исследования специфики ценностных ориентаций у студентов – психологов. Психологическая картина характеризует ценностные ориентации студентов-психологов как направленные на себя, свои личные цели и средства их достижения. Полученные данные позволяют сделать вывод о том, что ориентация на других, на ценности принятия, терпимости у студентов-психологов выражена слабо. Из чего следует несформированность у студентов важных для психолога ценностных ориентаций.

**Ключевые слова:** ценностные ориентации, студенты – психологи, направленность личности, М. Рокич.

**Аннотация:** В статье представлены результаты эмпирического исследования специфики ценностных ориентаций студентов-психологов. Психологическая картина характеризует следующие ценностные ориентации студентов-психологов: направленность на себя; на свои личные цели и средства их достижения. Полученные данные позволяют сделать вывод о том, что ориентация на других, ценности принятия, толерантности у студентов-психологов выражена слабо. Следует отметить, что среди студентов наблюдается недостаточная образованность ценностных ориентаций, важных для психолога.

**Ключевые слова:** ценностные ориентации, студенты - психологи, личностные ориентации, М. Рокича.

**Annotation:** The article presents the results of an empirical study of the specifics of value orientations among students - psychologists. The psychological picture characterizes the value orientations of psychology students as directed towards themselves, their personal goals and the means to achieve them. The data obtained allow to conclude that the orientation toward others, the values of acceptance, tolerance among psychology students is weakly expressed. It should be noted that there is a lack of education among students of value orientations important to the psychologist.

**Keywords:** value orientations, students - psychologists, personality orientation, M. Rokich.

**ACERTIVITY OF YOUNG TEACHERS ON THE EXAMPLE  
OF COUNSELOR AT THE CAMP "ARTEK"**

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**Introduction.** The formation of a growing personality as a subject of socialization becomes the fundamental line of the educational process in the system of modern domestic education, which finds its concrete embodiment in the real behavior of a teenager, their preparation for a conscious, responsible choice of their own position in the communicative space, the formation of such psychological properties that would allow them to fully enter the social sphere of society.

The problem of socialization of the younger generation in general and the development of the assertiveness of the individual as a subject of communication, in particular, is becoming especially relevant in the context of the changes in the social, political and economic life of our country.

The lack of formation of an individual's ability to set and implement his/her own goals and aspirations leads to dissatisfaction with life and the emergence of social fear.

**The main part.** "Assertiveness" scientists consider as the integrative ability of the person to be independent, self-confident, motivated by the successes and achievements. Taking into account the scientific developments of I. Kohn, G. Craig, N. Maximova [6], the sensitive period of assertiveness development is adolescence, when a person in the process of socialization and on the basis of formed self-esteem learns to manage spontaneous reactions, to defend one's own point of view, to argue reasonably, has a sufficient range of manifestation of emotions. In modern psychology, the main focus when considering the problem of development of assertiveness is given to working with the behavioral and motivational-value sphere of the personality, pointing out the complexity of differentiating the manifestations of confidence and aggressive behavior. Numerous psychological programs of active socio-psychological

training offer training aimed at developing confident personality behavior [1, 2, 3].

An analysis of the **relevance** and state of development of the research problem in psychological, pedagogical science and practice makes it necessary to resolve the contradictions between the assertiveness of adolescents, as an important factor in their socialization, and the personal space of others; between the increasing demands of modern society for the young generation and the unformed ability of the individual to create an effective communication environment. At the same time, our reality poses new challenges for scientists to coordinate positions and scientific argumentation regarding the characteristics of the development of personality assertiveness and psychological factors that determine this process in the teenage phase. The insufficient elaboration of the theoretical, methodological and applied aspects of the problem, the objective need of society in shaping the personality as a subject of socialization led to the choice of the topic of this study: "The development of the assertiveness of young people on the example of counselors of the Artek Federal State Budgetary Educational Institution".

Assertiveness is a personality feature, which differs by a positive social behavior that allows to protect your rights and achieve your goal [4, 5]. An assertive person can say "no" in those cases when it is necessary. He/she can openly declare his/her position and his/her desires, be responsible for his/her actions, praise and compliment, as well as accept compliments and criticism. An assertive person knows how to negotiate well and find mutually acceptable solutions, to stand up for himself/herself. Assertiveness is often confused with the ability to resolutely and categorically refuse. But a certain "no" is not enough to be, to become assertive. Assertiveness is the attitude of a person who, in communicating with other people, is guided by the principles of partnership and mutual respect. There is a risk to mix the concepts of assertiveness and aggressiveness. This combination is very important to avoid. After all, aggression is a behavior or action to harm another person or object or completely destroy it.

Working in the educational institution of the Federal State Budgetary Educational Establishment "Artek", you have a possibility to actively research the assertive behavior of preschool children (3-6 years old), schoolchildren (7-16 years old), youth (counselors Artek 18-25 years old). I want to emphasize the teaching staff, namely counselors Artek. Once upon a time in Pioneer times, Artek counselors sang their hymn:

"Counselor" is a calling word.

Let the ties burn brighter!

Work ready,

Ready to fight

He leads the guys!

And who is he/she, the counselor of Artek, today? What is he/she like? Where should modern girls and boys lead? What life guidelines and values should permeate his activities? Today's "Artek" makes high demands on the level of general culture, psychological and pedagogical skills and professional competencies of a teacher. It is very important that every educator, every teacher understands what assertive behavior is and, by his/her example, shows all its manifestations.

Communication with children in the camp should be developmental and educational. The teachers of Artek should give every child a good mood for 21 days, and this is quite difficult to do. Throughout, there are many negative influencing factors on a person's condition. Communicating with our counselors, we tried to identify the characteristics of the emotional sphere, the presence of anxiety, negative emotions, "invisible" fears by means of the method of M.Z. Drukarevich "Drawing of a nonexistent animal." After carrying out the experimental work, a repeated diagnostic study was carried out. The purpose of which was to test the effectiveness of the developed set of classes aimed at the formation of assertive behavior of counselors, the development of empathy and skills to express their feelings, emotional experiences by various means.

It was found that counselors with high assertiveness are more likely to present themselves in a positive way to society than educators with low assertiveness; they value their degree of comfort, their benefit to others, and the value of assertive behavior.

Assessment of one's appearance, according to statistics, very strongly affects a person's assertiveness: a high one increases, a low one – decreases. Female assertive behavior may differ from male. Women with higher assertive behavior are rated as less attractive. Teachers with high assertiveness are better at understanding the situation and solving the problem. Also, counselors with assertive behavior showed a higher tolerance for criticism, and perceive it as an incentive

**Conclusion.** Assertive behavior in the communicative pedagogical process is the best option for the counselor to communicate with children, leading to the formation of an independent and responsible person who can successfully solve problems – psychological, educational, industrial, etc. And this is the goal of modern humanistic education. Trying to develop assertive behavior, children begin to understand and accept their own social goals. For example, the child prefers to take an active position in the formation of the game activities, especially if he/she is able to clearly tell coevals about the idea of the game and about his/her desires.

The presence of adults who establish order does not play a decisive role. The desired coevals' responses and success in achieving one's own goals become the most significant motivations for using assertive skills. A

child with assertive skills learns to trust his/her own feelings and judgments, understand his/her own myself and avoid the excessive hope of approval by adults or coevals. It is very important that the study of the basics of assertive behavior be included in the course of STE (school of a teacher education).

**Аннотация:** в данной статье описана проблема социализации подрастающего поколения, молодёжи и развитие ассертивности личности. Формирование ассертивного поведения вожатых ФГБОУ МДЦ «Артек».

**Ключевые слова:** ассертивность, личность, поведение, вожатый, социализация.

**Annotationy:** this article describes the problem of socialization of the younger generation, youth and the development of personality assertiveness. Formation of assertive behavior of counselors of Artek. The result of a study of counselors' assertiveness is presented.

**Keywords:** assertiveness, personality, behavior, counselor, socialization.

UDC 37.07

#### **VARIABILITY OF THE CONCEPTS “PEDAGOGICAL STAFF” AND “PEDAGOGICAL TEAM”**

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**Introduction.** The history of the pedagogical profession is considered in modern literature deeply Enough. This profession appeared in the era of the emergence of society. Antenatal communities felt the need to transfer work experience from generation to generation. Tools were improved and got complicated. In this regard, it was necessary to organize the transfer of skills. So in ancient times groups of educators were formed. The development of statehood in ancient civilizations necessitated special institutions where the transfer of generalized experience of generations took place. Subsequently, entire castes formed, the social strata of people who carried out pedagogical activities. A feature of the pre-scientific period in pedagogy is that upbringing was carried out without professional training in special institutions.

**The main part.** Analyzing the historical context of the emergence of the pedagogical profession, we see that teachers have always been perceived as a special community or even a social group. To transmit knowledge was an honorable activity, to which only select people were allowed.

In modern conditions, the number of teachers has increased significantly. General secondary education has become affordable and compulsory for every citizen. Currently, the development of the pedagogical community is one of the strategic goals of the educational institution. In connection with the modernization of the education management system, there is a need for constant changes in the behavior patterns of pedagogical and managerial workers. The main actor in the implementation of state educational programs are schools, namely the teaching staff of these institutions. Education reform is impossible without reforming the pedagogical community.

In modern methodological and managerial literature, the community of teachers working in the same institution is called the “pedagogical staff” or “pedagogical team”. In pedagogy, there is a problem of the variability of the use of these concepts: in some sources they are used as identical, in others the concept of “pedagogical staff” is designated as preceding the concept of “pedagogical team”. Based on this, the purpose of this article is to determine the meaningful content of the concepts of “pedagogical staff” and “pedagogical team”.

Let us consider the concept of “Pedagogical staff” in more details. Modern ideas about this concept as a subject of pedagogical activity were formed in the late 19th and early 20th centuries in the works of K. D. Ushinsky, L. N. Tolstoy, N. I. Pirogov, A. S. Makarenko, and others who considered the role of a harmonious adult in raising a child.

The concept of “pedagogical staff” was firstly introduced by A. S. Makarenko, where he pointed out that “there must be a team of caregivers, and where caregivers are not connected in to the team and the team does not have a single work plan, a single tone, a single accurate approach to the child , there can be no educational process ”[7, p. 179]. According to A. S. Makarenko, pedagogical staff is a united educational team of an educational institution, the participants of which are educated along with teachers. Following the modern definitions of the pedagogical staff, students are excluded from this team [7]. Federal state educational standards of primary, general, basic general and secondary general education use the term “students”, but not “educated and do not contain norms that allow forming a single pedagogical staff in the understanding of A. S. Makarenko.

The concept of “pedagogical staff” is deeply studied in a modern scientific literature. Studies of M. E. Vayndorf-Sysoeva, I. V. Zhukovsky, Ya. L. Kolominsky, N. V. Kuzmina, S. V. Lazareva, J. M. Mitina, A. A. Rean, T. I. Rudneva, E. A. Selyukova, etc. are devoted to the formation

of a favorable psychological climate in pedagogical groups that affects the quality of the educational process.

In the work “Leadership of the pedagogical staff: models and methods” V. S. Lazarev defines the pedagogical staff as “a group of jointly working teachers with common educational goals, the achievement of which is also personally significant for them, and realizing the structure of interpersonal relationships and interactions that contribute to achieving common goals” [5, p. 25].

From the point of view of E. A. Selyukova, the pedagogical staff is “a self-governing professional community of educators of an educational institution, consisting of interconnected sex-role and multifunctional groups and separate individuals engaged in the implementation of a jointly developed and (or) accepted goal” [8, p. 92]. M. E. Vayndorf-Sysoeva claims that the pedagogical staff is a group of people with a high level of development, characterized by cohesion, integrative activity, and collectivist orientation [2].

So, the classical works on pedagogy and modern scientific articles on the organization of management of educational institutions reveal the content of the concept of “pedagogical staff”. Based on these works and interpretations highlighted by the authors, we can determine the distinctive features of the pedagogical staff:

1. The implementation of educational and educational activities;
2. The presence of a common conscious goal of pedagogical activity;
3. The multifunctionality of the members of the team (the composition may include both sex-role and multifunctional groups, as well as separate individuals);
4. Self-management;
5. Cohesion;
6. The collective nature of labor.

Next, we consider the concept of “pedagogical team”, since this term is increasingly included in the scientific vocabulary. In Europe, instead of the concept of “staff”, the following concepts are used as “team”, “management group”, “working alliance”. However, in the Russian view, the concepts of “staff” and “team” are usually distinguished. “The collective in Russian organizations is a long-term education and has clearly regulated managerial powers that are exercised by the leader, and the team gathers only to carry out a specific project, and all its members have equal powers” [7, p. 112]

So, researcher O. V. Efreanova interprets the concept of “pedagogical team” as a “group of specialists engaged in a targeted educational process to achieve a common goal and sharing responsibility for the results” [3, p. 200].

By I. Zhukovsky’s definition, the term “pedagogical team” is “... a group of teachers organized to work together to achieve a common goal and sharing responsibility for the results.” In addition, the researcher in his article

“Features of the creation of a pedagogical team: types, goals, values, interpersonal communication in a group of teachers in a middle school” calls the pedagogical team as one of the main innovative resources for the development of the school [4, p. 26].

In scientific works, E. A. Alexandrova considers the “pedagogical team” as a group of teachers of an educational institution and other subjects (parents, students, subjects of society, social partners, etc.), created to solve the strategic and tactical tasks of institution development [1]. We also note that E. A. Alexandrova sees a distinctive feature of the concept under consideration from the “pedagogical staff” in that the “team” is organized spontaneously, for certain purposes, from a group of people who are and are not members of the teaching staff. Such a “team” is united by common interests and tasks for the implementation of the creative nature of the pedagogical content, as a rule, of the strategic level of development of the educational institution [1].

Researcher N. A. Solovova considers the definition of “pedagogical team” through the prism of pedagogical psychology as “a group of specialists of an educational institution engaged in joint activities to implement a pedagogical project, connected by a commonality of motives, goals, values of pedagogical work, a developed sense of “we”, and the compatibility of members achieved a unity of professional preferences”[9, p. 23].

The formation of pedagogical teams is controversial. So, according to T. A. Tsinareva, the concept of “pedagogical team” exists exclusively within the framework of the higher educational system and is a special kind of teams. These teams are formed in a higher educational institution, where the content is determined by moral intellectual potential, research resources, experience of scientific and pedagogical activity, incentives, motives and goals of participants [10].

Thus, on the basis of various interpretations of the “pedagogical team” in the scientific literature, it is necessary to distinguish the distinctive characteristics of the content of this concept:

1. The implementation of educational and educational activities;
2. The presence of a common conscious goal of pedagogical activity;
3. Value-orientational and motivational unity;
4. Separation of responsibility for the result;
5. Cohesion;
6. Satisfaction from a team membership.

It should be noted that the modern pedagogical literature also does not adequately address issues related to the disclosure of the content of the concept of “pedagogical team”. This term is used mainly in dissertation research of modern teachers.

**Conclusion.** So, the concepts of “pedagogical staff” and “pedagogical team” often replace each other, however, along with general characteristics,

such as the implementation of educational and upbringing activities, the presence of a common conscious goal of teaching activity and cohesion, there are clear distinctive signs: for the pedagogical staff they are – multifunctionality of team members, self-governance and the collective nature of labor; for the pedagogical team - value-orientational and motivational unity, sharing responsibility for the result and satisfaction from belonging to the team.

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**Аннотация.** В статье рассматриваются вопросы связанные с характерными особенностями использования понятий «педагогический коллектив» и «педагогическая команда». В педагогике существует проблема вариативности использования данных понятий: в одних источниках они используются как идентичные, в других понятие

«педагогический коллектив» обозначено как предшествующее понятию «педагогическая команда». Целью данной статьи является определение вариативности и содержательного наполнения понятий «педагогический коллектив» и «педагогическая команда».

**Ключевые слова:** педагогический коллектив, педагогическая команда, воспитательная деятельность, вариативность, образовательное учреждение.

**Annotation.** The article discusses issues related to the characteristic features of the use of concepts of “pedagogical staff” and “pedagogical team”. In pedagogy, there is the problem of the variability of the use of these concepts: in some sources they are used as identical, in others the concept of “pedagogical staff” is designated as preceding the concept of “pedagogical team”. The purpose of this article is to determine the variability and content of the concepts of “pedagogical staff” and “pedagogical team”.

**Key words:** pedagogical staff, pedagogical team, educational activity, variability, educational institution.

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## **THE PHENOMENON OF ALEXITHYMIA WITH DIFFERENT LEVELS EMPATHY AMONG UNIVERSITY STUDENTS**

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**Introduction.** The problem of alexithymia began to be studied in the 70s of the XX century. The term “alexithymia” (from Greek “a” - absence; “lexis” - word; “thymos” - emotion) was introduced by P. Sifneos to denote

the individual's limited ability to perceive his/her own feelings and emotions, their adequate verbalization and expressive transmission [1].

The study of the phenomenon of alexithymia in the educational process (namely, in the process of studying at a university) is important, since violations in the emotional sphere reduce the ability of students to make various contacts, interfere with their personal development, in general, leading to social and psychological adaptation [2]. That is why this topic is relevant.

**Materials and methods.** The purpose of the article is a theoretical and empirical study of the relationship between the phenomenon of alexithymia and empathy on the example of a student group.

The object of study is the phenomenon of alexithymia.

The subject of the study is the specific relationship of alexithymia and empathy among university students.

Research hypothesis: it is assumed that there is a relationship between the level of empathy and the propensity for alexithymia in university students.

Research methods: questionnaire «Toronto alexithymic scale» (TAS), adapted at the Psychoneurological Institute by V.M. Bekhterev; Empathy Diagnostic Questionnaire I.M. Yusupova; factor analysis (STATISTICA 6.0 software).

The study was carried out on the basis of Sevastopol Economic and Humanitarian Institute of Federal Crimean University by V.I. Vernadsky during the 2019-2020 academic year. The study involved 17 first and second year students enrolled in undergraduate programs «Psychology». Of these, 14 (67%) are girls and 3 (33%) are boys aged 17 to 23 years.

According to the results of the methodology, one can see the general dynamics of the types of empathy among student psychologists (test by I.M. Yusupov). The level of empathy among psychology students is at an average level, that is, the ability to empathy is not sufficiently developed. It is necessary to conduct classes on the development of empathic abilities of students as an important personal characteristic.

According to the methodology «Torontian alexithymic scale», the following dynamics was distinguished among psychology students in terms of the level of development of their ability to recognize, differentiate, and express emotional feelings and bodily sensations.

Most subjects (76%) do not have alexithymia, that means this group of respondents has the most harmonious relations with themselves and the world around them. Understanding their own emotional states is not a problem for them.

There are also subjects (24%) who fall into the so-called «middle» zone - they do not belong to explicit «alexithymics», but they have problems with the expression of emotions; certain conflicts are inherent in relation to oneself

and the world. They tend to communicate with people around them, they need their support, attention and care, however, they experience difficulties in understanding their own feelings and their subsequent expression in contact with others. All this creates an atmosphere of internal stress, which finds expression in the feeling of general emotional discomfort [3].

For subjects in the «middle» zone, it is important to prevent the development of alexithymia in the future. To do this, it is worth taking preventive measures: to develop your creative abilities, to be included in the communicative sensual bright world of people, to interact with them, responding to their emotions.

**Results.** According to the hypothesis put forward, it was highlighted that there is a relationship between the level of empathy and the propensity for alexithymia in university students.

To process the results of the study, a factor analysis was selected (Table 1).

**Table 1 - Barriers to empathic abilities in psychology students: factor analysis (STATISTICA 6.0)**

Factor Loadings		
Extraction: Principal components		
(Marked loadings are > 0,700000)		
	<b>Factor</b>	<b>Factor</b>
	<b>1</b>	<b>2</b>
Empathy for parents	<b>0,795510545</b>	0,190451237
Empathy for animals	-0,552273816	-0,449504922
Empathy for the elderly	-0,573181118	-0,433597794
Empathy for kids	-0,549872561	0,506446626
Empathy for the heroes of works of art	<b>0,800238281</b>	-0,222915244
Empathy for strangers	<b>0,727176541</b>	0,511415276
Alexithymia scale	-0,165639297	<b>-0,764982022</b>
<b>Expl.Var</b>	2,765343226	1,579255865
<b>Prp.Totl</b>	0,395049032	0,225607981

**Discussion and Conclusions.** According to the results of factor analysis of the primary results of an empirical study, 2 factors were identified. Both factors are related and are part of the emotional component of the

psychologist. The first factor with positive and significant factor weights included the following components of empathy for parents ( $F1 = 0.8$ ); empathy for the heroes of works of art ( $F1 = 0.8$ ); empathy for strangers ( $F1 = 0.7$ ). The second factor is alexithymia ( $F2 = -0.76$ ). Thus, it can be noted that empathy is formed as opposed to not recognizing the emotions of other people.

The students-psychologists who have a tendency to alexithymia are not able to empathize with others. A non-empathic psychologist will not be able to feel into the emotional state of the client. Building a strong working alliance will be impossible as well. Such a specialist can be considered unsuitable. For this reason, psychology students need to develop empathy. To do this, they need to build the ability to recognize the emotions of other people, first of all, through empathy for loved ones and strangers, as well as for heroes of works of art. There are no statistically reliable relationships between the general indicator of alexithymia and empathic ability for animals, elderly people and children.

The focus of novice psychologists is the essence of another person, his/her problems, emotional state, behavior and thoughts. The specialist should feel his/her ability to be in emotional resonance with others: empathize, participate, build contact. We can say that the empathic interaction between the psychologist and the client is the foundation of an effective therapeutic process.

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**Аннотация.** В статье представлены результаты эмпирического исследования взаимосвязи различных видов эмпатии и алекситимии (не умение распознавать свои эмоции) на примере студентов-психологов. По результатам факторного анализа было выделено 2 фактора: в состав первого фактора с положительными и значимыми факторными весами вошли следующие составляющие эмпатия к родителям ( $F1 = 0,8$ ); эмпатия к героям художественных произведений ( $F1 = 0,8$ ); эмпатия к незнакомым людям ( $F1 = 0,7$ ). Второй фактор – алекситимия ( $F2 = -$

0,76). Таким образом, можно заметить, что эмпатия формируется в противовес не распознавания эмоций других людей.

**Ключевые слова:** алекситимия, эмпатия, факторный анализ, студент-психолог.

**Annotation:** The article presents the results of an empirical study of the relationship between various types of empathy and alexithymia (not the ability to recognize their emotions) on the example of the psychological students. According to the results of factor analysis, 2 factors were identified: the first factor with positive and significant factor weights included the following components of empathy for parents ( $F1 = 0.8$ ); empathy for the heroes of art ( $F1 = 0.8$ ); empathy for strangers ( $F1 = 0.7$ ). The second factor is alexithymia ( $F2 = - 0.76$ ). Thus, it can be noted that empathy is formed as opposed to not recognizing the emotions of other people.

**Keywords:** alexithymia, empathy, factor analysis, student psychologist.

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## **THE FOREIGN LANGUAGE EDUCATIONAL PROGRAMMES: THE ADVANTAGES AND DISADVANTAGES**

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It is 2020 year now. The leading communicational language is English by all means. It is the main communicative language between people from different countries. Today English is necessary for the adults not less then far the children. Why is it so? We are travelling, doing business, changing cultural values with the whole world. And all these concerns the growing generation. In future for many Russian young people poor knowledge of English will be the awkward fact as the poor knowledge of the native Russian language.

The questions concerning computer training programs were studied by N.B. Nazarova, E.S. Polat, R. Williams, K. Mackli, and the other authors. The productive educational technologies were studied by N.F.Koryakovtseva. But the most productive foreign language training programmes were not the subject of the study.

The purpose of this article is to describe the advantages and disadvantages of the foreign language programmes.

From the early childhood the new generation, got used to the moving pictures on the screen of the Ipad, doesn't perceive the grammar table in the

Student's book or the chat drawn by the teacher on the blackboard. And this generation is looking for most suitable alternative. What is the way out of this situation?

The computer technologies help the traditional school lesson and in some cases even substitute it. These computer programmes include:

- English language learning computer programmes;
- Different Internet resources for the self learning;
- Skype online schools.

The first attempts of transmission the foreign language teacher's function to the computer were taken even in 60's of the last century. That's why it is not surprising that today the English language teaching programmes can be found not only on the shelves of the computer shops or bookshops, but also in the computer applications catalog for the simplest smartphone and also in the online resources catalog [1]

Many of you remember that the CDs were applied to the English textbooks. They included different training exercises, tests, instructions. Along with the creation of the training manuals the multimedia textbooks were made. The textbook primarily had the special methodology which connected as a whole all its components and implemented the definite algorithm for learning foreign language with the aim of the maximum assimilation to the material. The material mainly was based on the system «Talk to me». [2] On this system a real dialog between the user and the computer was modeled with the help of the voice recognition technology.

The programme reconstructs «the training educational medium» in which the baby is placed at the early stages of his development. Also such kinds of work as «Talk with the computer», phonetic exercises, lexical exercises (such as words associations, filling the gaps, «Erudite» game) and word order exercises are provided.

The programme analyses the student's voice, estimates his pronunciation and helps him to improve.

The advantages of the multimedia textbooks are:

- The high visibility;
- Interactivity (the students study the material with their own speed);
- The immediate control of the studied material.

At the same time there are the disadvantages of the multimedia textbooks :

- The age and personal peculiarities of the students are not taken into consideration;
- There is no succession of the lexico-grammatical material.

Closer to 2012, the offline computer programmes are changed by the different English learning Internet-resources. The multimedia sites for the children learning are created. Here are the most demanded, among them Lingva Leo Dualingo [2]

These resources offer the learning of the foreign in the form of the game. The child collects puzzles, finds associations to the words, learns with the cards. These sites have their own mobile applications.

The advantages of the Lingva Leo Duolingo resources:

- The context learning of English;
- The vocabulary and grammar material are given with the examples;
- The minimum of the time necessary for the learning;
- 20 minutes a day is enough.

The disadvantages of the Lingva Leo Duolingo resources

- The same type of the material;
- The forms of the work are not changed within each level of studying;

- The cyclicity due to which the interest is lost;

- The content is not free;

- The time for the free usage doesn't give the whole educational base [2].

While using the computer programmes and multimedia sites the main factor of the successful learning any foreign language is not taken into consideration: The face to face communication with the native speaker is necessary. In the following example of the computer this moment is considered.

Online schools. Mainly in these types of schools the classes are conducted on the bases of the special video-connection program-Skype. As a rule, the communicative approaches in learning English are offered: these are different video lessons, group lessons, individual lessons with the native speakers, interactive lessons [3]. Such schools also have their mobile applications, in which the student can improve his vocabulary bank.

The advantages of the Online school:

- They promote Not Dull English;

- All the video material and online lessons are not grammatical but lexical (For example, the topics music, art, etc.)

- Very ability and individual approach;

- At the beginning of the work the student is given a test, then he is filling an application form concerning his own interests.

Dead Line, or terms for completion the tasks. Each task has its own term of completion. Such approach makes you to study English, not to leave everything for the later.

The disadvantages of Dead Line:

- Age limits;

- Studying in the online schools is suitable more for the children of the Secondary schools and adults;

- High pay cost for the education (beginning from the 800 rubles, 1400 with the native speakers) [2,3].

Besides using the multimedia educational programmes, computer is necessary in the help of making and conducting tests, controlling educational process, the informational content of the tools for working out the computer lessons, preparation of the Supplementary materials, using the Internet for the students project work.

Conclusions.

The Introduction of the multimedia programmes into educational programmes does not exclude the traditional methods of learning but harmoniously interconnects with the them on the all stages of learning: acquaintance, training, application, control. But using the computer allows not only to improve the efficiency of learning but to stimulate the students for their further self-studying.

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**Аннотация:** Сегодня программы по изучению иностранного языка широко используются в образовательном процессе. Обычным школьным уроком на помощь приходят компьютерные технологии. В данной статье рассматриваются преимущества и недостатки обучающих программ по иностранному языку.

**Ключевые слова:** Обучающие программы; коммуникативный язык; преимущества; недостатки; компьютерные технологии; онлайн-школы; мультимедийные учебники; традиционные методы.

**Annotation.** The foreign language educational programmes are widely used in the educational process today. Computer technologies are used in the combination with the classical traditional lessons. This article considers the advantages and disadvantages of the foreign language educational programmes.

**Key words:** Educational programmes; communicative language; advantages; disadvantages; computer technologies; online schools; multimedia textbooks; traditional methods.

## SECTION 11: PHILOLOGY



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### HISTORICAL DEVELOPMENT OF MEANINGS AND STRUCTURE OF ENGLISH WORDS

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**Introduction.** English language changes over time at all its levels. In the course of language development, words varied in the structure [7]. The morphological system of language reveals its properties through the morphemic structure of words. It follows from this that morphology as part of grammatical theory faces the two segmental units: the morpheme and the word [7]. The morphemic structure of a word, determined by word-formation and morphemic analysis, is historical in nature. Throughout the historical development of English word formation, not only the phonetic composition, lexical meaning, grammatical properties, but also the morphemic structure has changed. From the point of view of language history, changing technique of the morphemic structure of a word is of great interest.

The **purpose** of this study is to analyze English word formation, namely the morphemic structure modifications.

At the stage of our work, the following **methods** were used: theoretical analysis of literature, World book dictionaries review.

The analysis of the morphemic structure makes it possible to identify the main historical processes that led to changes in the morphemic structure

of the word, namely the process of simplification, complication and re-decomposition.

Robert K. Barnhart, an American lexicographer and editor of various specialized dictionaries considered changes in the morphemic structure of the word. He was co-editor, with his father Clarence Barnhart, on some editions of the Thorndike-Barnhart dictionaries and The World Book Dictionary [6]. He edited the three volumes of The Barnhart Dictionary of New English, including all words changes.

Many scientists have studied the process of a simplification: V.A. Bogoroditsky [1], N.V. Krushevsky, N.M. Shansky [5], and others. They characterized a simplification as a change in the morphological structure of a word, when the word is decomposed into morphological parts [2].

Let's consider the process of a simplification. The transformation of the morphemic structure of a word occurs when the base in the composition ceases to allocate affixes in its composition and turns into the root. An example of a simplification in English is the word 'barn', coming from independent words 'bere' – 'barley' and 'ern' – 'house'. In modern English language the word 'barn' means the following: "a barn is a building on a farm in which animal food or crops can be kept".

Other examples from the English language are:

– *anniversary* (XIII) – Etymology: Latin anniversaries (adj.), formed on annus – year + versus – turning + ārius (ārium – feast);

– *belligerent* (XVI) – waging war. Etymology: formed on Latin bellum – war + gerere carry;

– *benediction* (XV) – Etymology: formed on Latin bene – well + dīcere – speak;

– *benefice* (XIV) – favour, benefit; ecclesiastical living. Etymology: formed on Latin bene – well + fic- variant of stem of facere – do, make;

– *belfry* (XIII) – bell-tower or chamber. Etymology: Old French berfrei, Frankish bergfrid, formed on bergan protect + friduz peace, shelter; the etymological meaning being 'defensive place of shelter' [6].

The opposite of the process of simplification is one of complication. A change in the morphemic structure of a word occurs when a previously non-derived base turns into a derivative. The complexity of the basis may be in borrowed words.

Repositioning is a change in the morphemic structure of a word, a redistribution of morphemic material within a word while preserving its derivative character, i.e., the articulability of the derived base into morphemes.

In addition to the "external" processes of simplification, transposition and complication, which are directly reflected in the word morphemic composition change, it is necessary to take into account the "internal"

process – decorrelation (changing the nature or meaning of morphemes and their ratio in the word while preserving the articulability of the word, the number and order of morphemes).

Changes in the morphemic structure of a word are detected using etymological analysis. Etymological analysis of the word establishes the origin of the word, its original structure and meaning, determines the nature of the historical process that occurred (or a combination of them) [3].

The process of repositioning develops in the language spontaneously, but sometimes this one is the result of a conscious modification of the morphemic structure.

In **conclusion**, it should be noted that the morphemic structure of the word, which is determined by word-formation and morphemic analysis, has a historical nature. Both the phonetic composition, lexical meaning, grammatical properties, and the morphemic structure has changed. From the point of view of language history, technique of the word morphemic structure changing is of great interest.

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**Аннотация:** В статье рассмотрен анализ морфемной структуры, который дает возможность выявить основные исторические процессы. Охарактеризованы следующие изменения в морфемной структуре слова: процесс опрощения, усложнения и переразложения.

**Ключевые слова:** история языка, значение слова, морфемная структура, упрощение, усложнение, переразложение.

**Abstract:** This article analyzes the morphemic structure, which makes it possible to identify the main historical processes. The following changes in the morphemic structure of the word are characterized: the process of simplification, complication and re-decomposition.

**Key words:** language history, word meaning, morphemic structure, simplification, complication, and transposition.

UDC 811

## **LEXICAL AND SEMANTIC FEATURES OF MARINE TERMINOLOGY OF ENGLISH-LANGUAGE TEXT**

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**Introduction.** The analysis of marine terminology, its structural and semantic characteristics and functional features provides information about one of the most significant fragments of the world picture of native English speakers. One of the system groups consideration of the lexical structure of the English language contributes to a better understanding of communication processes and systemic organization of the vocabulary of the language.

### **1.1 Relevance of the research**

The study of vocabulary not separately, but in an integral part of the lexical and semantic spheres, allows to consider one of the fragments of the world picture of representatives of English-speaking culture and identify their specifics [4]. Therefore, it will be relevant to describe the features of the nomination of marine terms in the English language, which allows to

identify specific features of the corresponding lexical systems, as well as correlations between the conceptual models of native English speakers within the study area of knowledge. Since Great Britain is an island country, the realities associated with the sea have always been of paramount importance to it.

It is obvious that in the picture of the World of the British Isles, concepts related to the sea and the fleet occupy one of the most important places.

The lexical-semantic feature is a dynamic, developing system that is inextricably linked with other semantic ones that are members of the same language model of the world.

### **1.2 Study of the problem**

Geeraerts Dirk considered lexical semantics as the study of word meaning. He stated that «first, linguistic semantics is obviously not restricted to lexical semantics: for a broader view of meaning in language, including the crucial areas of grammatical and discursive semantics, see the article Semantics. Second, although the label ‘lexical semantics’ may suggest otherwise, morphological semantics (the study of the meaning of morphemes and the way in which they combine into words) is usually considered a separate field from lexical semantics proper» [3, www]. Cruse D.A. emphasized that lexical semantics is the branch of linguistics which is concerned with the systematic study of word meanings [2].

Robin K. Morris, Jocelyn R. Folk analyzed lexical-semantic ambiguity. On their mind, multiple word meanings are activated and meaning is resolved within the readers’ initial processing time on the ambiguous word [6].

Marie-Claude L’Homme explores the interconnections between lexical semantics and terminology. The researcher shows «how principles borrowed from lexico-semantic frameworks and methodologies derived from them can help understand terms and describe them in resources» [5, www].

Andy Chiu, Pascal Poupart, and Chrysanne DiMarco said that the core of our analogy generation system is based on the use of a dependency grammar [1].

Lexico-semantic field of marine terminology in the English and Russian languages was considered by O.G. Kozlovskaya, A.I. Skorikova, S.A. Pankratova, S.V. Grinev and others.

### **2 The aim of the research**

The purpose of this article is to analyze marine terminology, its structural and semantic characteristics and functional features which provides information about one of the most significant fragments of the world picture of native English speakers.

### **3 Materials and methods**

The distributive method is used to determine semantic processes in the language. This method is based on checking the use of marine terms in the same field. Along with this, the comparative method is also applied. The comparative method is a general scientific method of comparing facts and phenomena. Only by means of comparing based on the process of thinking, semantic processes related to marine terminology are generalized, while certain similar patterns are identified.

The research material was selected from the Maritime Conventions: STCW-78/95, SOLAS, MARPOL, ISPS CODE.

#### **4 Results and discussion**

Lexical and semantic processes in the language system, including terminology, occur as an expression of general laws and principles of lexical development.

From the point of view of the structural organization of marine terms, among the constituents of marine terminology terms-phrases prevail in the texts which appeared at the later stages of the development of the marine term system. More ancient origin in English are terms-non-derived words (*boat, ship etc.*), terms of suffix type (carrier, drifter etc.), terms formed from verbs by conversion (*ship, float, tow etc.*) and using the word structure (*watchkeeping, safety-management, fire-extinguishing, etc.*)

Explicative phrases are quite frequent formations in the context of English Maritime terminology.

Let's consider the phenomenon of *ambiguity* in marine terminology. Most polysemous words appeared as a result of transferring the qualities of one word to another. In marine terms, as well as in terms of other industries, certain lexical and semantic processes occur, one of which is polysemy. Polysemy is usually understood as the expression of several meanings, various phenomena, social relations, objects and their features in one term.

Dictionaries of marine terms, taking into account their ambiguity, should reflect the meanings associated with navigation.

Thus, such lexical and terminological units as verbs, transforming into nouns, acquiring a new qualitative state, develop their inherent semantics. For example, *Every person in charge will require an appropriate GMDSS certificate.* Term «*in charge*» can also mean «*отвечать, курировать, командовать, заведовать, на попечении, во главе, в ведении, в обязанности, за главного, у власти, у руля, в обвинении, в заряд, отвечающий, занимающийся, курирующий, ведающий, ответственный*».

Let's consider the phenomenon of *synonymy* in marine terminology. In the terminological system, the existence of synonymy is usually the result of different approaches to the same object, different perceptions of the same phenomena.

In English some marine terms can be translated using synonyms: (*be responsible for someone, anything; be responsible for, be in charge.*)

Some examples from STCW Convention are the following :

*Companies will **be entitled to request** foreign administration to confirm that certificates issued to seafarers serving on their ships are actually valid and authentic.*

*Governments will **be required** to maintain a register of all certificates and endorsements for masters and officers.*

*Every person **in charge of or performing** radio duties on a ship operating under the global maritime distress and safety system (GMDSS) will require an appropriate GMDSS certificate.*

#### **4 Conclusion**

The main provisions in this paper are summarized as follows:

1. The study of semantic processes in marine terminology primarily determines the boundaries of homonymy-polysemy.
2. The same terminology unit is used in different terminology
3. Ambiguity in language is an essential part of language, it is often an obstacle to be ignored or a problem to be solved for people to understand each other.
4. Homonymy in marine terminology appears based on the internal rules of the language.
5. Synonymy in marine terminology is based on the factor of semantic generality.

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**Аннотация.** Автор рассматривает структурно-семантические характеристики и функциональные особенности морской терминологии. Материал исследования был отобран из морских конвенций: STCW-78/95, SOLAS, MARPOL, ISPS CODE.

**Ключевые слова:** морская терминология, неоднозначность, синонимия, полисемия, лексико-терминологические единицы.

**Annotation.** The analysis of marine terminology, its structural and semantic characteristics and functional features provides information about one of the most significant fragments of the world picture of native English speakers. The research material was selected from the Maritime Conventions: STCW-78/95, SOLAS, MARPOL, ISPS CODE. Lexical and semantic features of marine terminology of research material are analyzed.

**Keywords:** marine terminology, ambiguity, synonymy, polysemy, lexical and terminological units.

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## **SPECIFICATION OF NON-EQUIVALENT VOCABULARY IN MARINE ENGLISH**

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Modern society faces an all-embracing process of globalization, affecting all spheres of human activities. English language makes international communication possible that is why the knowledge of language peculiarities and culture becomes necessary. As a rule, the educational process takes place out of the appropriate language environment, which causes certain difficulties in getting acquainted with the rules, unfamiliar culture and its national and cultural features.

The lack of professional language environment is not the only obstacle that hinders the mastering of marine English by cadets of maritime universities. They are the peculiarities of marine English that cause a difficulty for future workers of water transport, among the above mentioned peculiarities non-equivalent vocabulary is of great challenge for the cadets.

The objective of this manuscript is to determine a specification of non-equivalent vocabulary in modern marine English and the most used methods of its rendering.

For this purpose, we shall reveal the definition of non-equivalent vocabulary, a non-equivalent vocabulary is a lexical unit of one selected source language or dialect that does not have regular (full or partial) dictionary matches in the translation language.

The main methods of translating non-equivalent vocabulary from English into Russian in technical marine language, which are most commonly used for texts or communication, are also analyzed here.

A non-equivalent vocabulary is a lexical unit of one selected source language or dialect that does not have regular (full or partial) dictionary matches in the translation language. The purpose of non-equivalent vocabulary is finding a translation or making an associating with it.

The absence of precise and constant lexical correspondences to any word does not mean neither is it impossible to convey its meaning in context, nor is it untranslatable in the future, however there is always a need to create new words or new meanings already existing words. Any word can be translated into another language at least descriptively. What is not possible to an individual element is possible to a complex whole, i.e. with regard to contextual translation. Possibility correctly convey non-equivalent vocabulary and concepts associated with it, assumes certain knowledge about the reality in which this vocabulary functions.

There are two main difficulties in translating non-equivalent vocabulary [2.p. 27]:

1) the lack of an equivalent in the translation language due to the lack of native translations of this language denoted by a foreign lexical unit of the subject;

2) the need, along with the subject meaning of the word, to convey its color, its specific sense.

Specification of non-equivalent vocabulary is in problem of localization words on other languages without usage of different ways of translation.

A.O. Ivanov divides all nonequivalent vocabulary into three big groups [4, p.35].

1. Referentially – nonequivalent, which includes term, individual (author), neologisms, semantic lacunas, words of wide semantics, complex words;

2. Pragmatically – nonequivalent, uniting abnormalities, foreign inclusions, abbreviations, words with suffixes of subjective evolution, interjections, imitation a sound and associative lacunas;

3. Alternatively – nonequivalent vocabulary including proper names, circulation, realia and phraseologisms.

All non-equivalent words can be translated in several ways [1, p.12]:

1.transliteration; i.e. the borrowing of a foreign word, which is represented by the letters of the translation language

2. calque; it is a translation of parts of a foreign language word or a combination of words with the subsequent addition of the translated elements together.

3. saving the graphic form;

4. descriptive translation: is a method, which consists in revealing the value of the original unit using a detailed description

5. abbreviations.

Calque is the most famous way of translation non-equivalent vocabulary from English into Russian. 36% of words are translated by it.

For example:

Check(проверка),power(мощность),bandwidth(пропускная способность), sensor (датчик), *anchoring* (постановка на якорь), challenge (проблема), *балансирующий руль* – balanced rudder, *двойное дно* – double bottom

The second most popular method of translation is transliteration. It is employed in 31% cases of rendering non-equivalent vocabulary.

The examples are the following: mechanism (механизм), technique (техника), *ballast* – балласт, slingers-слингеры , *анод* – anode, *буй* – buoy, *барк* – bark, *блок* – block, *бункероваться* – to bunker

The next method of translation is abbreviation which is deployed in rendering 27% of non-equivalent lexics. [3,p,52]

DOC – Document of Compliance

FO – Fuel oil

FSA – Formal Safety Assessment

Radar – Radio Detection and Ranging

Scuba – Self-Contained Underwater Breathing Apparatus

LST – Local Standard Time

Marisat – Maritime Satellite System

PSC – Port State Control

And the least used methods of rendering non-equivalent vocabulary are descriptive translation and abbreviation of words .Only 4% of all translated words:

*вспомогательный мостик* - flying bridge, *выбрать слабинку* – to take up the slack, lower piston surface – подпоршневая полость, out of action – не работать, water-cooled- экранированный, spray-факел распыла, Управляемость – *Steering quality*, *Low margin* – приносящими низкую валовую прибыль

Speaking about non-equivalent vocabulary, I have to say about different non-equivalent phrases that were born on fleet, but widely used in our modern life form explaining many different situations. The main method of their rendering is a descriptive method least used and the most specific ,in my opinion.

**jump ship** – быстро уйти из проблемной ситуации / покинуть компанию: «*They didn't like their new manager, thus they all jumped ship*»

**know the ropes** - начинающий моряк, мало в чем разбирающийся. It's his first contract. *He only knows the ropes.*

**Under the weather** - плохо себя чувствовать. *Don't ask me to stay, I'm a bit under the weather so I'm going to bed early tonight*

**Feeling Blue** – грустить. *He feeling blue. May be I can cheer him up?*

**By and large** – в общем и целом. *By and large our repairment gone well.*

**deep-six** – отказаться, проигнорировать. *Sorry, but I have to deep six your proposal.*

**to get everything shipshape**- навести порядок. *The overhauling is done. Now we have to get everything shipshape.*

**Cut and run**- быстро уйти, чтобы избежать беды. *The storm is coming. We have to cut and run.*

In conclusion, marine English non-equivalent vocabulary is treated very widely from the point of availability of translation equivalent and usage in different languages, therefore the number of nonequivalent words is extremely growing in marine English. In that case big attention should be paid to such lexical units to make learning of marine English easier and more relative to your native language.

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**Аннотация.** В данной статье определены методы перевода неэквивалентной лексики в современном морском английском языке. Данная статья была разработана с целью улучшения изучения морского английского языка для курсантов морских вузов. Научная новизна состоит в оценке всех методов и рассмотрении наиболее и наименее полезных из них. В результате проведенных исследований были выявлены и показаны основные проблемы локализации неэквивалентной лексики на примерах морского английского языка.

**Ключевые слова:** неэквивалентная лексика, морской английский язык, способы перевода, лексическая единица, идиома.

**Annotation.** This article defines methods of rendering non-equivalent vocabulary in modern marine English. This article was designed with an idea of improving studying of marine English for cadets of marine

universities. All methods of rendering are described with percentage of usage. Scientific novelty consists of evaluation of all methods and considering the most and the least useful one. As a result of research, major problems of localization of non-equivalent vocabulary were detected and shown on examples of marine English.

**Keywords:** non-equivalent vocabulary, marine English, methods of rendering, lexical unit, idiom.



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