

ДИАЛОГ КУЛЬТУР

МАТЕРИАЛЫ XV МЕЖДУНАРОДНОЙ НАУЧНО-ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ НА АНГЛИЙСКОМ ЯЗЫКЕ

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COMPARATIVE ANALYSIS OF SOFTWARE DEVELOPMENT METHODOLOGIES

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Abstract. This article discusses the concept of software development methodology (software), analyzes existing development models, and compares their advantages and disadvantages in order to identify the most relevant methodology to date.

Keywords: development, product, project, software, model, methodology.

СРАВНИТЕЛЬНЫЙ АНАЛИЗ МЕТОДОЛОГИЙ РАЗРАБОТКИ ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ

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Аннотация. В данной статье рассматривается понятие методологии разработки программного обеспечения (ПО), анализируются существующие модели разработки, а также сравниваются их преимущества и недостатки, с целью выявления самой актуальной на сегодняшний день методологии.

Ключевые слова: разработка, продукт, проект, программное обеспечение, модель, методология.

Each product received has its own life cycle, a set of different sets through which the entire development process passes. The cycle begins already at the stage of planning and creating a person or revealing any ideas, after which a large number of successive and interconnected stages follow, leading to results to results. One of the most important issues and in many cases is the choice of

methodology or development model. Let's take a closer look at this stage to get some development models, what tasks they solve, what to use them for, and also compare the main techniques to get a complete understanding of what they are for.

What is a software development model? This is primarily a structure that systematizes various types of project activities, as well as their interaction and sequence in the development process. By choosing this model and building work around it, day one employees understand what they are doing and why, thus the entire workflow will move steadily and efficiently [1].

As for the tasks that determine the development methodology, we highlight the possibility of them:

1. Solve problems within the team in accordance with the criteria.
2. Helps to form a sequence of steps, as well as limit the requirements for the final product.
3. Contributes to saving development time by minimizing the number of edits and corrections of the project, as well as due to a clearly built action plan.
4. Gives an understanding of how to implement an idea and create a product that is useful for business.

The choice of one method or another is justified by a qualitative approach to discussing software, because otherwise the product may get stuck at the development stage and not be implemented due to a clear action plan. To date, there are a sufficient number of different models, including the special methodology of rare companies, but how widespread are 7 typical methods that have passed the test of time and have repeatedly brought their effectiveness [2].

Let's take a more remarkable one and start with one of the oldest models, which I call the Waterfall (waterfall model). It got its name due to the successive passage of the necessary stage, which, due to necessity, completely ends before the next, such an incredible descent, similar to a waterfall. If we give a frequent methodology, then everything is not so simple here, because thanks to a strong propensity for regulation, project management becomes very simple, but at the same time, the cost of an error in this format is extremely high. you must wait for the completion of the entire project and you should not expect changes at any time.

Logical development and consideration of the detected shortcomings to the verge of the V-shaped model (V-model). A step-by-step structure has been preserved here, but fundamentally vague in how this stage is implemented in the implementation of the project. Such a model aims to thoroughly validate and test a product that is already in the early stages of development. Each stage on the so-called “start-up” is followed by a testing stage on the “rise”, thereby monitoring the project and making adjustments right during development.

The fundamental basis of modern approaches to software development is the Iterative incremental model. The name makes us understand that the system has a certain duality: from the point of view of the life cycle, it is iterative, i.e., implies repeated repetition of the same stages, and from the point of view of product development, it is incremental. A feature of this technique is the

division of the entire project into small iterations, which may include all the usual stages that we met in previous models, and after the iteration, we get an increment (increment) of the product functionality, which is expressed in an intermediate build (build). The length of iterations depends on many factors, but testing and demonstration of software to the customer is applied continuously throughout the project.

A variation of the incremental model is the spiral model. They are distinguished by the fact that the spiral model pays special attention to risk analysis. It works well for mission-critical business challenges where failure is incompatible with the company's operations or when a new product line is being launched. Explicitly, the spiral model identifies 4 key phases:

1. Planning and elaboration of goals, alternatives and restrictions
2. Risk analysis
3. Creation of an intermediate version of the product, design
4. Evaluation of results and transition to the next cycle

This format is not suitable for small projects and it makes sense to use it only in complex and expensive ones, for example, the development of an EDMS for a bank, where each stage requires more careful analysis to assess the consequences than programming.

Now let's move on to the most common and relevant today Agile software development methodology (Agile model), which is a combination of various methods and is based on the "agile manifesto", which says [3]:

1. People and interaction are more important than processes and tools. If a company wants to build a flexible process, then the employees in it must interact and communicate with each other, while using various available tools, for example, trackers – JIRA, Redmine, etc.
2. A working product is more important than comprehensive documentation. Let's take 2 examples: one company has a finished product that can already be put into operation, thereby starting to make a profit for the customer, and the second company has technical specifications, layouts and other documentation, but all this is of no value to the user. he cannot apply it due to the unavailability of the product.
3. Cooperation with the customer is more important than agreement on the terms of the contract. Not always fixed, rigid time limits, scope of work and deadlines are a good solution. Often, it is better to build partnerships with the customer and look for compromises in order to get bilateral benefits – the software was created in comfortable conditions, and the customer got exactly what he wanted.
4. Readiness for change is more important than following the original plan. According to this manifesto, 8 principles of the Agile model can be formulated:
 1. The highest value is customer satisfaction through regular and early delivery of software.
 2. Willingness to change the project even at its most advanced stages when some new features appear.

3. A working product is released as often as possible according to the manifest and the deadlines specified in it.
4. Business and developer alignment is essential for programmers to understand the specific market for which they are releasing software.
5. The terms “team” and “leader” are the basis of the entire model. A team of motivated professionals will achieve the best results. The leader, in turn, must create favorable conditions for the work of these people, monitor the atmosphere in the team and its emotional state.
6. According to numerous studies, we can confidently say that the best communication is face to face, because the easiest way to find out the requirements and desires of the customer is simply to talk to him. Also, the productivity of the meeting can be helped by various visualization tools, for example, a whiteboard or just sticky notes.
7. Flexibility should also be shown in technical aspects. The architecture of the code should be such that it is easy to add various elements to it or change them.
8. Self-criticism and constant analysis. The team must constantly try to analyze both their mistakes and their success in order to improve their skills with experience.

Agile assumes that when implementing a project, it is not necessary to rely only on pre-created detailed plans, but it is important to focus on the constantly changing conditions of the external and internal environment and take into account feedback from customers and users. This motivates developers and engineers to experiment and look for new solutions without limiting themselves to rigid frameworks and standards [4].

Also, this methodology has two separate approaches. The first of these is scrum – the “structure approach”. Two more people join the working team of the project: the product owner and the scrum master. The first is needed in order to establish communication between the team and the customer, as well as to monitor the development and progress of the entire project. The second one helps the owner organize the business process. The Scrum Master conducts general meetings, solves everyday problems and monitors compliance with the Scrum approach.

This approach divides all work into equal sprints – usually these are periods lasting from a week to a month, depending on the scale and tasks. Before the start of such a sprint, tasks are formulated, and at the end, the results are discussed. Thus, it is very convenient to compare sprints with each other, which allows you to manage work efficiency.

The second approach to the agile software development model is Kanban or the “balance approach”. His task is to balance different specialists within the team and prevent such cases that, for example, designers are loaded with work, and developers are unhappy with the lack of new tasks. In this format, the whole team is a single entity and does not have those additional roles that are present in scrum. As for the business process, here it is not divided into sprints, but at the stage of performing specific work: “planned”, “in development”, “tested”,

“completed”, etc. The main indicator of effectiveness in Kanban is the average time passing the task on the board. This indicator is analyzed and after that a decision is made on the effectiveness of the team's work [5].

Thus, we can conclude that today the most relevant is the agile software development methodology, because it has a number of significant advantages over outdated models and uses their experience, but at the same time, agile is not the only right solution, because the methodology is partially intersecting in means and are somewhat similar to each other, and the choice of a particular model depends on the scale of the project and its specifics.

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CIRCUITRY OF THE FUNCTIONAL UNIT OF THE AIR FLOW METER WITH THE USE OF AN ION LABEL

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Abstract. This paper discusses the circuit design and development of ion-label air flow meter units for an atmosphere monitoring system.

Keywords: airflow meter, ion label, unipolar ion label, atmospheric monitoring systems.

СХЕМА ФУНКЦИОНАЛЬНОГО БЛОКА РАСХОДОМЕРА ВОЗДУХА С ИСПОЛЬЗОВАНИЕМ ИОННОЙ МЕТКИ

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Аннотация. В статье описывается схема и разработка блоков расходомеров воздуха с ионной меткой для системы мониторинга атмосферы.

Ключевые слова: расходомер воздуха, ионная метка, униполярная ионная метка, системы мониторинга атмосферы.

Introduction

To solve the problems of measuring the air flow velocity, the most promising converters are based on unipolar ion labels, which represent local area of the air flow with an increased concentration of unipolar ions formed as a result of a short-term spark discharge produced in the incoming flow. This label can be formed in a small amount of flow, and its gas-dynamic properties practically do not differ from the properties of the air medium, which ensures full compliance of the parameters of the movement of the label with the characteristics of the airflow.

An important advantage of unipolar ion labels is the possibility of their registration by a non-contact method, namely with the help of metal electrodes, on which, due to the effect of electrostatic induction, a pulse signal is induced during the passage of a charged label. In this case, the electrodes can be isolated

from the flow by a dielectric material, which ensures high reliability of the converter when exposed to moisture, dust, etc. [1]

The paper considers the features of the circuit design and selection of the element base of the functional units of the ion-label air flow meter.

Ion Label Generator

It is advisable to construct a high voltage pulse generator according to the scheme shown in Figure 1:

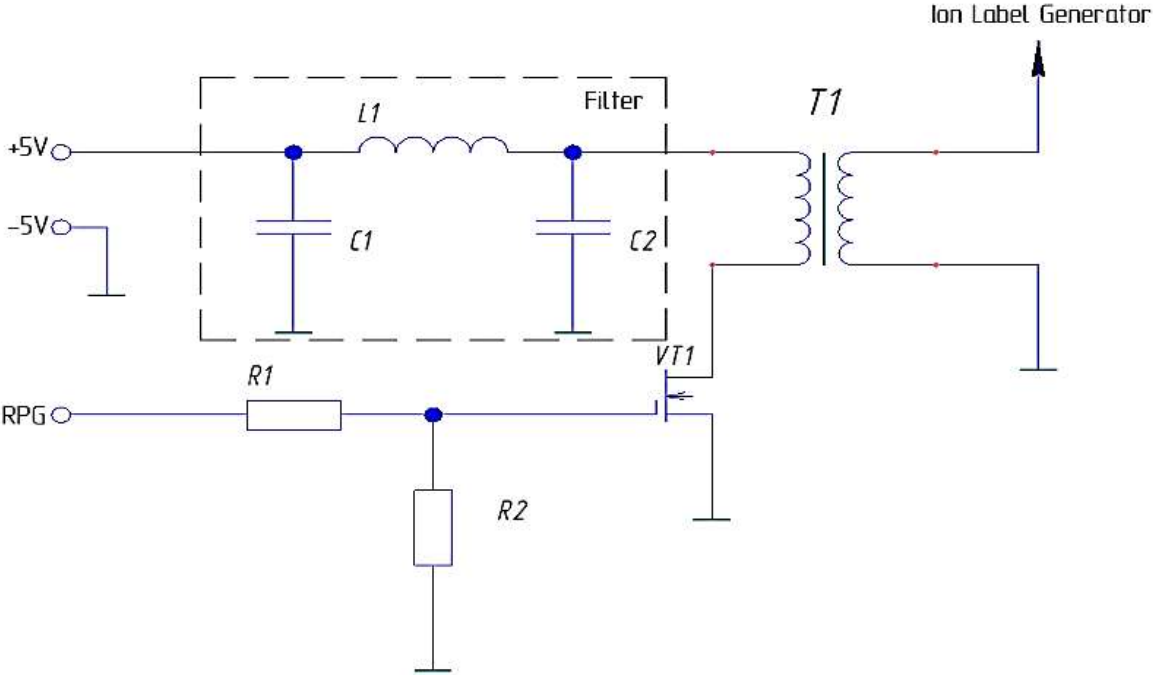


Figure 1. Generator of high-voltage pulses

In Table 1 the specification of generator elements is shown:

Table 1 – Specification of generator elements

<i>Designation</i>	<i>Name</i>
C1	Capacitor K10-17B-N90-1UF±20%
C2	Capacitors K10-17B-Y5V-4.7 UF=20%
R1	Resistor CF -25-0.25-470 Ohms ±5%
R2	Resistor C2-23-2-100 kOm ±5%
T1	Transformer
VT1	Transistor IRLML6344TRPBF-N-channel-30V-5A

Analog key

The analog key is required to open the circuit at the start of the measurement in order to eliminate interference from the control unit at the remote-control input. 2 analog keys are needed. To reduce the dimensions, we use a two-channel precision analog key with a single-pole power supply MAX325CPA. The pinout is shown in Figure 2:

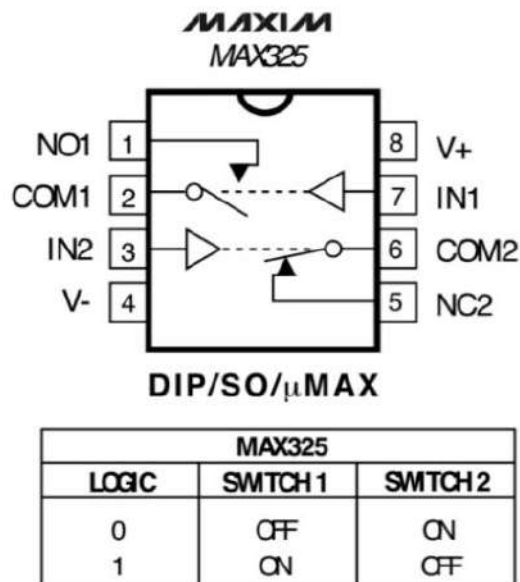


Figure 2. Pinout of the analog key

COM1 and COM2 are switches, inputs IN1 and IN2 get signals from recorders, output signals will come from ports NO1 and NC1.

Label Logger

The electrical diagram of the recorder is shown in Figure 3. Terminals 1 and 2 are connected to the recording electrodes. The signals coming from the recording electrodes pass through the pre-amplifiers, which must be sensitive to these signals [2].

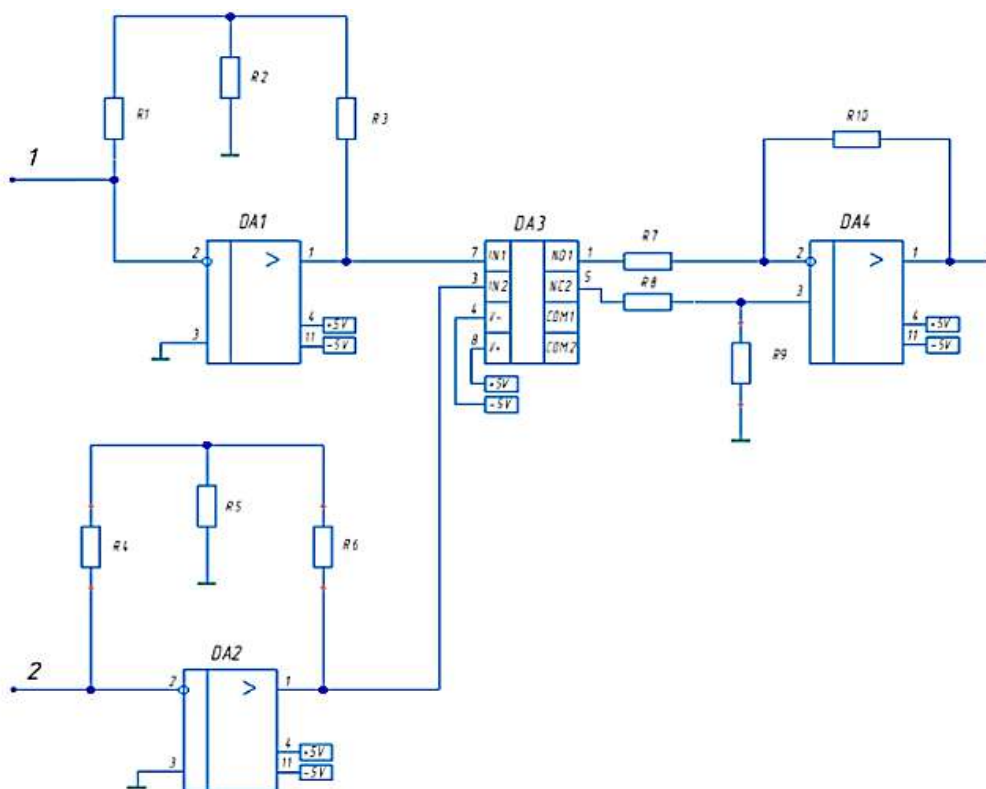


Figure 3. Label recorder

Therefore, it is necessary to select operational amplifiers DA1 and DA2 with a large input impedance. To reduce the overall dimensions, we will focus on the operational amplifier K140UD12. The DA3 key is connected to the microcontroller via ports COM1 and COM2. It controls the incoming signal.

The K140UD12 is a quad micro-power operational amplifier designed to operate in a wide voltage range from a single power source. It is also possible to work from a source with bipolar power. The IP contains:

- Current stabilization scheme with the start-up circuit;
- Four independent operational amplifiers.

On Figure 4 K140UD12 is shown:

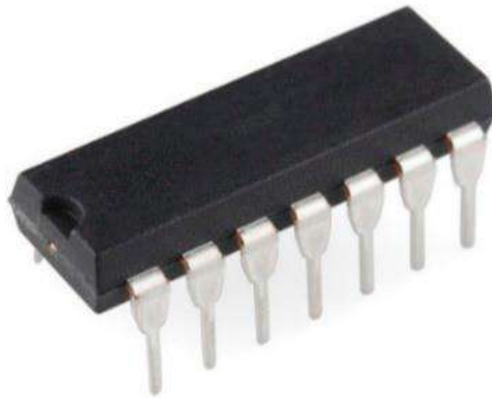


Figure 4. Housing 401.14-5M. Part type K140UD12

Features of K140UD12:

- 1) Voltage range of the power supply:
 - Unipolar power supply $3 \div 32$ V
 - Bipolar power supply ± 1.5 V $\div \pm 16$ V
- 2) The output voltage is consistent with all types of logic circuits
- 3) Operating temperature range: $- 60$ °C $\div +125$ °C

Integrator

Figure 5 demonstrates the integrator:

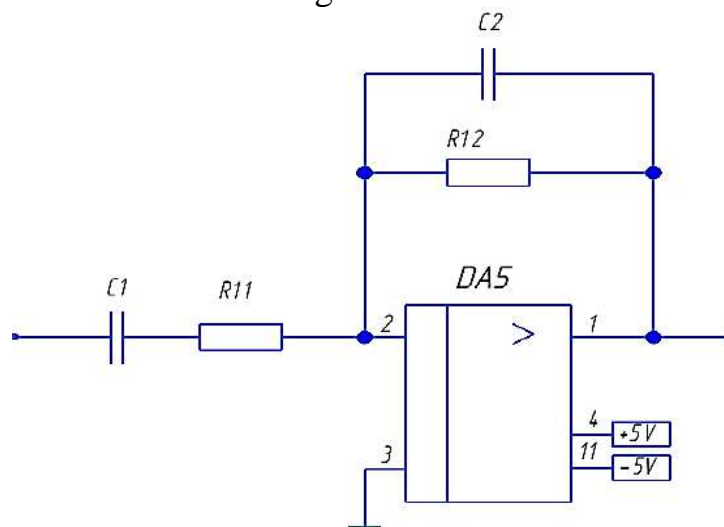


Figure 5. Integrator

The voltage U1 and U2 from the outputs of the amplifiers DA1 and DA2 are supplied to the inputs of the differential amplifier DA4. The difference signal from the output of the differential amplifier goes to the DA 5 integrator, which is a low-pass filter [3].

Thus, we have technically implemented an ion-label air flow meter. We were able to achieve energy, economic and dimensional efficiency.

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IN SEARCH OF THE BEST MODERN ALTERNATIVE SOURCES OF ELECTRICITY

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Abstract. New ways of getting electricity are considered in this article. The objects of study are a wave machine, a wooden sponge, a pneumatic generator and carbon nanosheets.

Keywords: new energy source, pneumatic generator, wave machine, wooden sponge, carbon nanosheets, nanotechnology.

В ПОИСКЕ ЛУЧШИХ СОВРЕМЕННЫХ АЛЬТЕРНАТИВНЫХ ИСТОЧНИКОВ ЭЛЕКТРОЭНЕРГИИ

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Аннотация. В данной статье рассматриваются новые способы получения электроэнергии. В качестве объектов исследования используются волновая машина, деревянная губка, пневматический генератор и углеродные наноллисты.

Ключевые слова: новый источник энергии, пневматический генератор, волновая машина, деревянная губка, углеродные наноллисты, нанотехнология.

The electric power industry is one of the most important branches of the energy industry, which includes the production, transmission and sale of electric energy [1, p. 8].

Currently, there are a large number of ways to generate electricity, most of which are based on the use of non-renewable energy sources (with the exception of hydropower). The generator is the main element of such productions. The rotation of the turbine, which drives the generator shaft, is provided with energy from the burned fuel (thermal power), hydropower of rivers (hydropower), energy of a controlled nuclear chain reaction (nuclear power). In turn, the generator shaft rotates, generating electrical energy.

In alternative (non-traditional) energy, energy is generated using alternative energy sources. The main alternative energy sources are considered to be wind energy, hydropower of small rivers, solar energy, the use of which, due to the instability of energy generation, forces us to look for new sources of energy generation [2, p. 113]. One of the most important tasks of our time is the development of new types of electricity generation. Therefore, the development of new promising alternative ways of generating energy is being actively pursued.

Of the fundamentally new ways to generate electricity, Blue X can be called. Blue X is a wave machine 20 meters long and weighs 38 tons. The wave machine was installed at the test site of the European Marine Energy Center, located in Scotland, where such a power plant is being actively tested.

The Scottish Government is providing strong financial support to the Blue X project, which will help to achieve Scotland's ambitious plan to reduce its impact on the climate by reducing carbon emissions by 75 % by 2030, and by 2045 will help achieve net zero emissions. The project developers estimate that tidal energy could power 50 million homes and reduce carbon emissions by 50 million metric tons annually by using just 1 % of the world's available wave energy. At present, the Blue X on the test site is showing results that are in line with design calculations, but the power of the test wave machine is only enough to power a remotely controlled underwater vehicle. Therefore, the main direction for further research of this method of generating electricity is to increase power. With stable financial support, this project has a high chance of industrial launch of the use of wave machines for the power supply of large coastal cities.

Of considerable interest is the method of generating energy using the so-called “wooden generator”. No matter how strange it may sound, but electricity can be obtained with the help of all of us familiar wood. Thus, teams from a state research university and a federal laboratory in Switzerland proved that wood is not just a building material, it is something more. They have already succeeded in improving the properties of wood in order to use it for new applications – they have developed a highly durable, water-repellent and magnetizable wood. Using one chemical and one biological process, they succeeded in generating electrical voltage from a type of wooden sponge, thus enhancing the previously known “piezoelectric effect” of wood [3, p. 138]. The elastic deformation of the piezoelectric material generates an electrical voltage. The same phenomenon is exploited by measurement technology, using sensors that generate a charge signal when mechanically stressed. Wood also has a natural piezoelectric effect, but is only capable of generating a very low electrical voltage. In order to increase the stress, it is necessary to change the chemical composition of the wood, which will also change its compressibility. In order for wood to turn into an easily moldable material, one of the components of the cell walls must be dissolved. The cell walls of wood are made up of three main substances: cellulose, hemicellulose and lignin. Lignin is a stabilizing substance that trees need to grow tall. If the lignin is chemically

removed, the wood may be more deformable. As a result, its piezoelectric effect is enhanced. The researchers were able to achieve this delignification by placing the wood in a mixture of hydrogen peroxide and acetic acid. After dissolution of lignin with acid, a framework of cellulose layers remains. So, a piece of wood becomes a white wooden sponge, which consists of layers of thin cellulose. Such a sponge can be easily compressed, after which it will return to its original shape.

Tests of a wooden sponge were carried out on a test cube, the length of the sides of which was equal to 1.5 cm, about 600 load cycles were performed. It was found that at each load, the measured pressure the voltage was about 0.65 W, which is remarkably stable. In later experiments, the scalability of such a “wooden generator” was tested. Experimentally, it was found that a mini power plant assembled from 30 wooden blocks, provided that the weight of an adult is evenly loaded, enough electricity can be generated to power a simple LCD display.

“Wooden generator” definitely has a huge potential, because such generators can be used in homes without any damage to humans and the environment. For example, the floor in apartments can be turned into a mini power plant if it is made from such wooden sponges, and any movement around the apartment will lead to the generation of energy that can be spent on the needs of residents. So far, this is an undeveloped type of alternative energy that requires improvements for further widespread use.

One of the scientific breakthroughs of our time is the method of obtaining electricity from the air or a pneumatic generator – Air-gen [4, p. 118].

The history of this method of obtaining energy began relatively recently. About 30 years ago, scientists found an unusual microorganism on the banks of the Potomac River, which, according to them, is able to help generate electricity. This sedimentary microorganism was named *Geobacter*. Scientists have discovered that this microorganism is capable of producing magnetite (natural iron oxide), and that *Geobacter* is able to create bacterial nano-wires that are excellent conductors of electricity. Thanks to this, humanity has taken a huge step closer to its cherished dream – obtaining electricity in the literal sense from the air.

In search of a practical use for this unusual ability of this microorganism, in 2020 a scientific group from the University of Massachusetts created a device called the Air-Gen or pneumatic generator. The generator uses electrically conductive nano-wires produced by the microorganism *Geobacter*. Air-Gen combines protein nanowires with electrodes so that the water vapor present in the atmosphere generates an electrical current. The pneumatic generator, according to its creators, is capable of generating electricity in its pure form 24 hours a day. This can be called one of the most rational ways of using protein nanowires. Air-Gen as a new power generation technology has significant promise.

If we consider in more detail the principle of the device of a pneumatic generator, we can say that it consists of thin films that are made of protein nano-wires with a thickness of 7 to 10 micrometers. These films are located between two electrodes suspended in air. A nanowire film capable of adsorbing water vapor present in the atmosphere allows a continuous electric current to be generated between the two electrodes. A charge is created due to the moisture gradient, which creates the diffusion of protons in the nanowire material. This charge diffusion induces a balancing electric field and a potential the same as that in biological resting membrane systems. The nanowire device produces a continuous output voltage due to the maintained humidity gradient [5]. The air generator is capable of generating a voltage of about 0.4 – 0.6 volts with a current density of about 0.15 – 0.20 $\mu\text{A}/\text{cm}^2$. Despite the fact that these values are very small, scientists assure that by connecting several devices it will be possible to generate enough electricity to charge low-power devices such as smartphones. The pneumatic generator is surprisingly capable of working even in extremely dry places such as deserts. Scientists now face the challenge of creating larger systems of pneumatic generators to power entire homes. It is planned to introduce nano-wire into wall paint.

Thus, Air-gen, although a very young way of generating electricity, is very promising. Pneumatic generators do not need any maintenance, and are able to receive electricity literally from nothing, thus the discovery of such a method of generating electricity is a global step in the development of the electric power industry.

Scientists from the Massachusetts Institute of Technology are actively working to find new ways to generate energy, and in addition to the already mentioned nano-wires, they have managed to develop hollow carbon sheets made from a lattice of carbon atoms. Researchers have noticed that tiny particles of carbon, simply interacting with the liquid surrounding them, can create a current [3, p. 137]. The current is generated by the liquid pulling electrons from the particles. This current can be used to power micro- and nano-robots. In 2010, it was demonstrated for the first time that carbon nanotubes can generate “thermal energy waves”. Electric current is created when heat pulses or waves are thermoforces move along a nanotube coated with a layer of fuel. It has been found that when creating asymmetry by coating part of the tube with a Teflon-like polymer, electrons begin to flow from the coated to the uncoated part of the tube, thereby generating an electrical current. By immersing the particles in a solvent, some of the electrons can be pulled out. To use this ability, the nanotubes are crushed and formed into sheets of a paper-like material. One side of such a sheet should be covered with a polymer similar to Teflon. Then fine particles of 250 by 250 microns should be cut into the sheets. By immersing these particles in an organic solvent such as acetonitrile, the solvent adheres to the uncoated surface of the particles and begins to draw electrons from them. This is a fairly simple way to generate electricity without the use of complex battery chemistry. The scientists explain that this is just a particle that is placed in a solvent, after which it begins to

generate an electric field, the solvent in turn takes electrons, and the system tries to balance by moving electrons. Currently, using this method of generating electricity, you can get about 0.6 – 0.8 volts. Studies have shown that an array of hundreds of such particles can be formed in just a small test tube. Such a reactor generates enough energy to drive a chemical reaction called alcohol oxidation, in which alcohol is converted to an aldehyde or ketone. Usually such a reaction is not carried out using electrochemistry, since it requires too much external current.

Thus, generating electricity from particles of carbon nano-sheets can be on a par with such familiar alternative energy sources as solar panels and wind power plants. Such “generators in a flask” can generate a fairly large amount of electricity, without having any large dimensions, literally a flask is enough for them.

The use of alternative sources such as Blue X, wood generator, Air-Gen and carbon nano-sheets is especially promising for applications in remote areas where it is not economically viable to use traditional methods of energy generation or it is simply geographically impossible to use alternative energy sources familiar to us, such as wind generators, hydroelectric power plants or solar generators. Such alternative energy sources cannot yet completely replace traditional energy, but with proper research and development of these technologies, they have every chance of first being introduced into power supply systems to duplicate traditional energy, and in the long term become the main method of energy generation.

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SPAM AND ANTI-SPAM METHODS

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Abstract. The paper reveals the concept of spam and its types. The methods of effective struggle with advertising letters are given. The description of methods of filtering and protection from spam is considered.

Keywords: spam, sending messages, filtering emails, e-mail, spam protection, phishing.

СПАМ И МЕТОДЫ БОРЬБЫ С НИМ

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Аннотация. В работе раскрываются понятие спама и его виды. Приведены методики эффективной борьбы с рекламными письмами. Рассматривается описание способов фильтрации и защиты от спама.

Ключевые слова: спам, рассылка сообщений, фильтрация писем, e-mail, защита от спама, фишинг.

The distribution of advertising on the world Wide Web does not contain a specific legal basis and is often based on pseudo-contractual relations between persons who do not have sufficient information about each other. One of the simplest, inexpensive and economically justified ways of conducting marketing work in the global network is considered to be the spread of spam.

Spam mailings take up space in an electronic mailbox, distract from important information, and become a serious cause of data loss, including system hacking. It is necessary to take the necessary measures to prevent spam from entering the mail. If the filters are incorrectly configured, on which the result of the fight against spam depends, spammers will have a way to bypass filtering in order to send a newsletter to all server addresses.

Spam is a mass mailing of messages to persons who do not want to receive it. Such mailings may contain advertisements for goods and services or links to phishing websites to collect user information [1].

Spam is classified according to several criteria:

1. By distribution area (online and offline);
2. By the distribution method (automatic – using automated programs and services; manual);
3. According to the degree of danger (safe – carried out for the purpose of advertising, the content of which does not harm the user; dangerous – carried out for the purpose of stealing data, money).

Safe spam is an advertisement of goods and services, both legal and prohibited by law. Sending compromising emails, which also belong to safe spam, is connected with politics and aims to discredit competitors. And also, the so-called “letters of happiness”, which are text messages in messengers with a request to forward to other users so that something good happens or bad does not happen. Spammers use such messages to collect data into a database of addresses for subsequent spam mailings.

Dangerous spam is harmful to the user and is carried out to steal money and data. There are several types of such dangerous spam:

1. Phishing

Fraudsters, posing as a bank or any well-known company, send a message or letter containing a link to a website and looks the same or rather similar to a genuine website. On the website, the user is asked to enter their data. To encourage the user to speed up data entry, banners with information tempting to click on it may appear on the page. When clicking on the link or entering personal data, bank details, information about the user will leak to fraudsters, which will entail serious losses.

2. Nigerian letters

The beginning of distribution was received in Nigeria. The user is promised a large amount of money, for example, an inheritance, but he is required to pay a fee. As soon as the scammers receive this transfer, they immediately interrupt communication with the user.

3. Malware

The emails contain links, when clicking on which you can catch a virus. A caught virus can infect a computer, thereby stealing data, providing remote access to a hacker. Network viruses are actively sent to the user's contacts, harming them [2].

There are a lot of sites and e-mail boxes that are gaining popularity among users who have the necessary protection from dangerous spam. These include the use of spam filters that automatically block messages that pose a threat to harm.

E-mail is the most common place for spam, since emails do not pass verification before being sent, their content is not limited by anything. Spam filters start working after sending.

Such platforms as forums, comments on websites and social networks are very popular among spammers. If there is no moderation, then spammers can freely publish any information. The presence of verification of publications allows you to use platforms for hidden advertising.

There are several methods of sending spam:

1. Manually. Such mailing is carried out from a real address or from e-mail boxes opened for such purposes. Blocking by email addresses is ineffective because spammers can start new mailboxes.

2. Using special programs and utilities. This method is automated. The spammer uses a special program that contains a database with addresses for sending emails.

3. Through incorrectly configured mail servers. This method is based on the implementation of the search and the use of SMTP servers with incorrect configuration. They are used for unauthorized mailing.

4. Spam bots – an autonomous Trojan program, against which IP filters are powerless, replenishes the database with the found email addresses for further spam distribution [3].

There are many popular methods of combating spam. To limit the mailing list, you don't have to be an IT specialist.

Methods of struggle:

- If the user has not subscribed to the newsletter, then it is enough for him to unsubscribe from it by using the unsubscribe link. The main thing is that it works correctly and does not lead to an empty or non-existent page.

- To register on insignificant sites with an account linked to the mail, it is better to use an additional mailbox, thereby it allows you not to get spam to the main mail.

- In order not to lose important emails in the general list of incoming messages, you need to set up sorting by creating folders where spam will not get into.

With the advent of new methods of spam mailing, new ways to deal with them are also emerging. For example, blacklists (DNS-based Blackhole Lists). They can be private and public. Private blacklists are configured by users not to receive messages from specific senders. For large aggregators of spam mailings, public blacklists are used. Providers and mail services that use them block IP addresses (both one and similar) from which spam messages are sent. The disadvantage of this method is that filtering unwanted emails may not work correctly, thereby the user may lose an important message.

Another method of struggle is content filtering based on the analysis of the mailing list content. The blacklist includes emails with the content of words, text and images that are characteristic of spam. This method is effective, but very labor-intensive. This method is mainly used by corporate users, because employees of anti-spam laboratories have to fine-tune filters. Spammers, in order to bypass content filters, apply its modification. And such a setting recognizes all modified messages in the same way and blocks them.

You can also fight spam with the help of technical means. This task falls on the system administrator, who needs to configure filters for email addresses without losing important emails. You can stop spam both on the server (the letter will not get into the user's mailbox) and after receiving the letter (a warning about the danger of the message appears in the letter) [4].

The number of Internet users is increasing every day, which means that spam mailing is relevant to this day. Legal ways to combat spam do not work properly. Therefore, technical and software tools are still the most reliable and effective to block spam.

To choose certain tools for blocking spam, you need to start from what the user or organization needs. It is also necessary to understand how to distinguish a spam message, what to do with it. Fighting spam is part of information security, which means that knowing the basics is extremely important.

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THE PROBLEM OF RECYCLING DISPOSABLE TABLEWARE IN RUSSIA ON THE EXAMPLE OF PAPER CUPS

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Abstract. In this study an attempt has been made to prove the negative impact of paper cups on ecology and environment. The composition of paper cups, methods of their processing and recyclable materials obtained as a result of processing were studied.

Keywords: paper cups, plastic, recycling, cellulose, pulpboard.

ПРОБЛЕМА УТИЛИЗАЦИИ ОДНОРАЗОВОЙ ПОСУДЫ В РОССИИ НА ПРИМЕРЕ БУМАЖНЫХ СТАКАНЧИКОВ

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Аннотация. В данном исследовании предпринята попытка доказать негативное влияние бумажных стаканчиков на экологию и окружающую среду. Были изучены: состав бумажных стаканчиков, способы их переработки и материалы, пригодные для вторичной переработки и полученные в результате нее.

Ключевые слова: бумажные стаканчики, пластик, переработка, целлюлоза, целлюлозный картон.

One of the current problems is the use of disposable tableware. The problem with using this product is that it is a one-time use, which increases the amount of waste. The Ocean Conservancy says single-use plastic cups are the biggest danger to marine life, and according to the non-profit organization 5Gyres, they rank seventh among the garbage that pollutes beaches. The most acceptable alternative is paper disposable tableware. Consider the example of paper cups.

Paper cups are actively used in the modern world. This is an item for its functional purpose, not intended for reuse. It should be noted that most catering establishments constantly use the services of disposable tableware, without thinking about the harmful effects of the used product on the environment.

Paper cups are a complex product: a coffee shop cup is the result of an advertisement that consists of a basic white cup and branded packaging, which is an extra source of paper for recycling.

Since the paper used to create disposable tableware does not retain liquid due to its physical properties, manufacturers are forced to use auxiliary materials to create these products. In order to avoid leakage of paper cups, the inner and sometimes the outer walls of the cup are covered with a special polypropylene film or an LDPE coating is applied (the so-called polyethylene, which has the properties of HDPE and PVP) [1]. Difficulties arise when recycling cups with a plastic layer, since waste paper recycling plants do not accept this recyclable material: this object is a composite material, that is, it does not consist of a homogeneous recyclable material. The plastic cover is very thin and is firmly attached to the paper backing, making the recycling process cumbersome. Fortunately, there are factories ready to process this composite material.

When organizing the recycling of paper cups (as well as other disposable tableware), one of the main difficulties is the narrow network for receiving this waste. In St. Petersburg, a collection of a small number of paper cups has been organized. Various projects are engaged in this activity, one of them is the Zelenka EcoProject, which offers an export service and has open reception points. In Moscow, the network for collecting this waste is a little wider; there is an Ecocenter “Sborka”, which accepts 40 types of recyclable materials [2].

According to information from the Ecocenter “Assembly” [2], at the moment there is only one processing plant in Russia – SEMP (Solnechnogorsk Pilot Mechanical Plant), which is located in the Moscow region [3].

The recycling process consists of three stages (Figure 1):

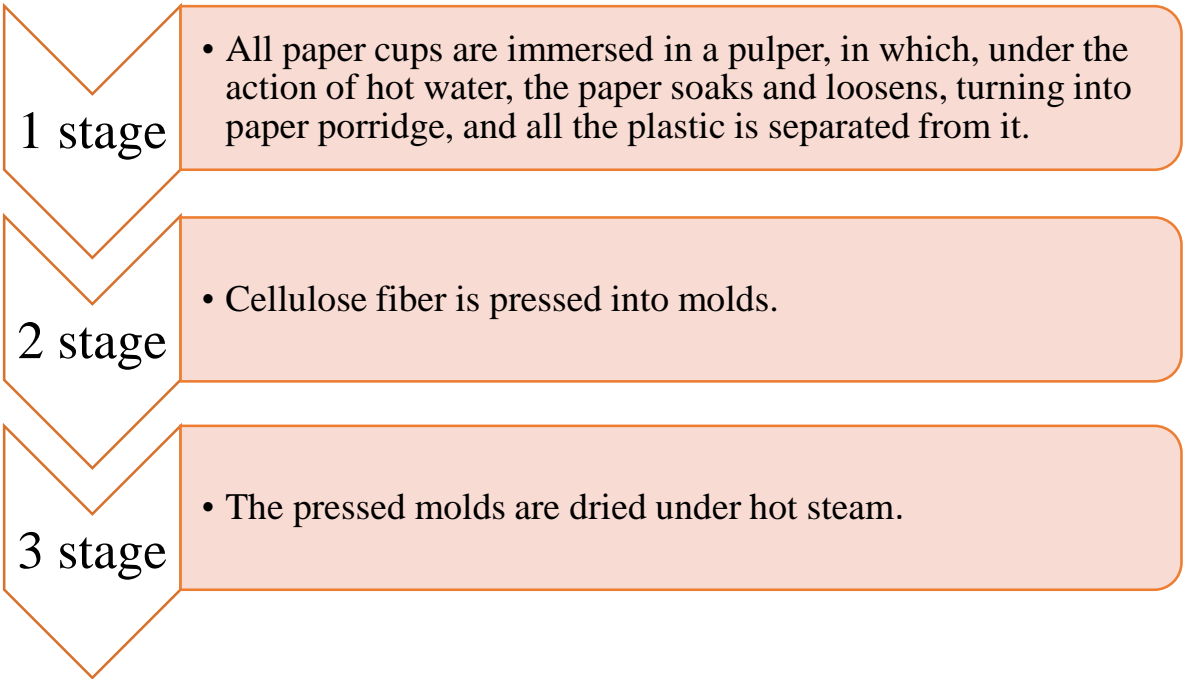


Figure 1. Stages of processing

After processing, pulpboard is obtained from the paper part, which is used in various areas (supports, packaging for equipment, packaging for seedlings). Pulpboard is an eco-friendly material because it can even be made from dirty paper, can be recycled into itself many times, and serves as compost when it has completed its own life cycle. It is worth noting that plastic leftovers are currently being thrown away. In an audio interview, the executive director of SEMP mentioned the possible acquisition by the enterprise of the necessary installations capable of qualitatively cleaning polyethylene from paper fiber [3]. This plant would represent opportunities for the recycling of polyethylene. In the future, such plastics are ready to be converted by pavement manufacturing plants, which would be an example of down cycling. Down cycling is a process in which a mixture of various non-recyclable materials is used to produce durable products. In Moscow, there is a vivid example of this phenomenon: paving slabs made from recycled toothbrushes. Therefore, such use is also possible for high-quality recycled plastic, which is in the composition of paper cups. Pulpboard is also down cycling and is considered the end of paper's life.

Despite all the prospects for recycling paper cups, they are not an environmentally friendly material. In addition to the above, the cups are used together with lids made of polystyrene. This type of plastic is very difficult to recycle. Pure cellulose is also used to make a glass: at the seam, the drink comes into contact with paper, which is the reason for additional regular deforestation (32 million trees are cut down worldwide for paper cups) [4]. The issue of recycling is gaining importance: at the moment there is only one plant in Russia ready to process this material, and the centers for receiving paper cups are not common in cities.

The turnover of paper cups in Russia is high: according to Greenpeace, about 41 billion paper cups are used annually in Russia, and only a small part is recycled [4]. For the production of this product, one plant buys about 15-20 tons of paper at a time, if we take on average that 1 ton of paper is extracted from 24 trees, then 1 company kills 360-480 trees for one wholesale purchase.

Frugal cup recently launched recycled paper cups that are not covered with plastic wrap [5]. A separate block of very thin waterproof plastic is inserted into such a paper base. When the drink runs out, the plastic block is simply removed from the paper block and each part is sent for recycling. The first such cups arrived in coffee shops in the UK this spring, but such trends will not reach us soon, and importing this product will be an expensive service, and the problem exists here and now.

In the period 03/03/2022-03/04/2022, a survey was conducted [6], in which 70 people took part. The survey contained 3 mandatory questions: How often do you take drinks with you in paper cups? Why don't you stay for a drink in a reusable container at the place where you bought it? Would you like to have

a reusable drink mug with you? and one extra: For those who don't have reusable portable drinkware: why haven't you got one yet? According to the survey results, it can be seen that 10 % of the respondents drink hot drinks almost every day (on average, if we take working days Minus weekends and holidays, then this is 247 days * 7 paper cups / per day = 1729 paper cups consumed by only 7 people per year) (Figure 2).

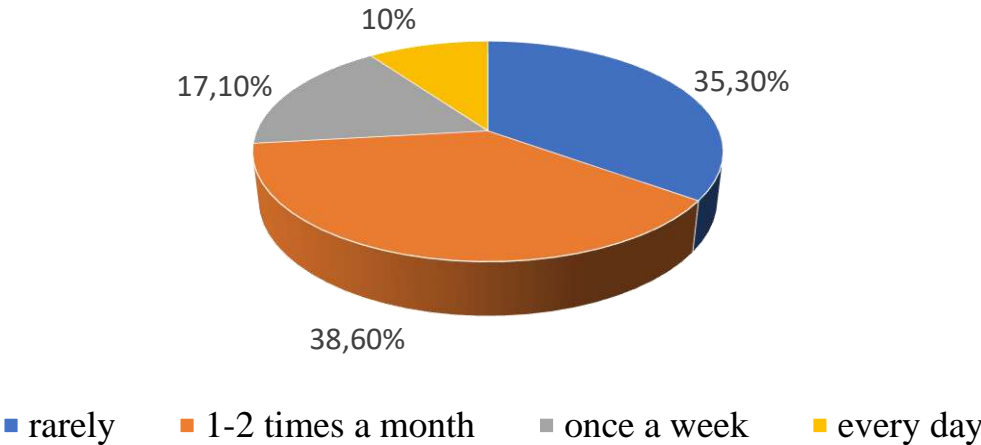


Figure 2. How often do you drink takeaway drinks in paper cups?

The reason that people take drinks with them is most often the lack of time or the inability to use reusable dishes in this institution [6] (Figure 3).

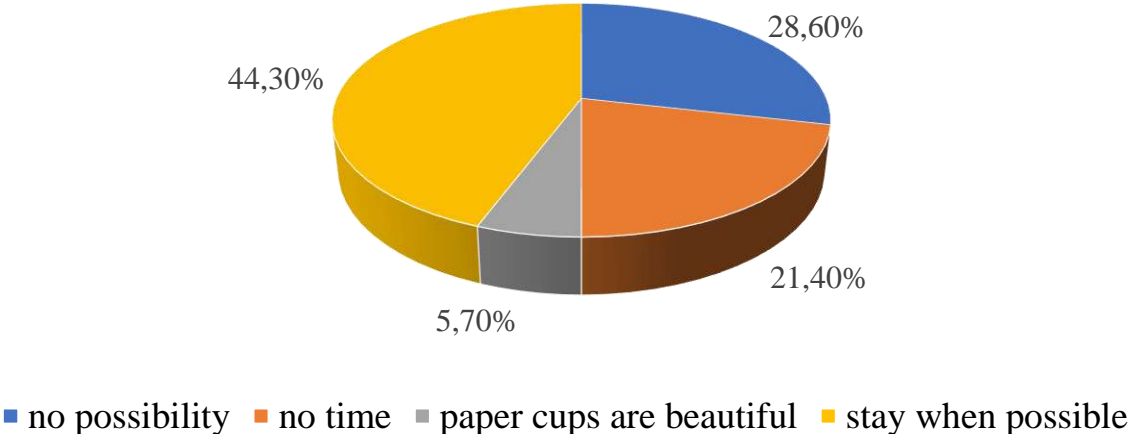


Figure 3. Why don't you stay for a drink in a reusable container?

The results obtained allow us to state that more than half of the survey participants would like to switch to their own reusable dishes (portable thermoses or thermo mugs), and almost a quarter already have something similar [6] (Figure 4).

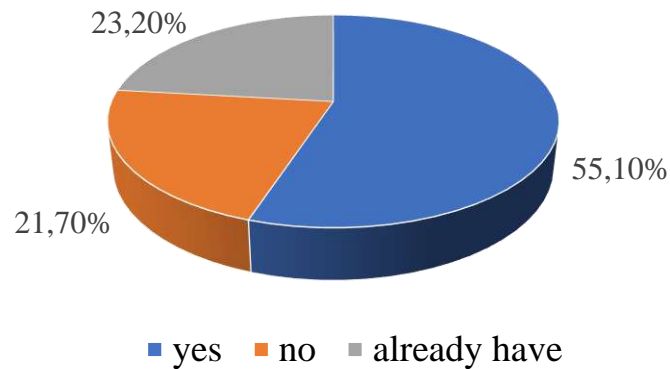


Figure 4. Would you like to have your own reusable tableware?

So, we can conclude that people are active consumers of paper cups. The reason for this may be the lack of reusable dishes in the institution itself or personal reasons. Many people want to abandon disposable tableware, and someone is already practicing it. As the executive director of SEMP, the only paper cup processing plant in Russia, said: “Reusable is always better than disposable, but if you have a paper cup in your hands, you can either pretend that it does not exist or hand it over for recycling” [3].

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ARTIFICIAL INTELLIGENCE IN NAVIGATION

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Abstract. The paper discusses the development of artificial intelligence in the field of navigation and autopiloting of vehicles and vessels. As a result of discussing the topic, a hypothesis is expressed about the further development of artificial intelligence in the field of navigation.

Keywords: artificial intelligence, navigation, autopilot, data set, detection.

ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В НАВИГАЦИИ

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Аннотация. В работе рассматривается развитие искусственного интеллекта в сфере навигации и автопилотирования наземных и наводных транспортных средств. В результате выдвигается гипотеза о дальнейшем развитии искусственного интеллекта в области навигации.

Ключевые слова: искусственный интеллект, навигация, автопилот, набор данных, обнаружение.

In our modern age, technology is keeping up with the times. Factories are acquiring more and more new equipment, robotics is developing, and we have achieved great success in space exploration. We can continue this list for a very long time, but today we have to talk about navigation and the participation of artificial intelligence in complicated systems – cars controlled by artificial intelligence (autopilot system, like in Tesla cars) and delivery provided by drones without any operators.

The most obvious example is on the surface – you just have to open your phone. Most OS already have this app installed – and yes, I'm talking about maps, like Google Maps or Magic Earth It uses pictures from satellites, like

pictures of streets, and then AI comes out calculating various types of way. You can even select a filter – the cheapest way, with fewer transfers and so on. There is a very interesting thing about AI – it can be used in marine robotics! Marine company Moller-Maersk will test a situation assessment system based on Artificial Intelligence (AI) on board one of its new Winter Palace ice-class container ships. Sea Machines has committed itself to installing a machine vision system that uses identification and range determination using light (LiDAR), as well as recognition software. In the future, the companies plan to expand the capabilities of AI, allowing it to track not only surface obstacles, but also underwater ones. So, for example, the ship will be able to maneuver through coral reefs, marine debris and migration routes of fish or marine mammals (whales, dolphins) without any harm for the environment. As for the Russian companies, presented analysis shows that today marine robotics is still at the stage of theoretical researches. However, there are already projects and programs in which the use of AI in the MRTC performs real practical tasks. Numerous AI studies are currently underway in Russia, mainly for unmanned aerial autonomous vehicles (UAVs). At the same time, it should be noted that both in marine robotics in general and in the application of AI systems, Russia is significantly lagging behind in comparison with foreign works in the practical implementation and commercialization of developments. One of the main constraining factors is the insufficient development of domestic electronic components and new generation technical means that are necessary for the implementation of such projects.

Now, let's think not about just ships, but for the whole vehicle system. In 2019, Elon Musk presented new microchip for self-driving cars to the world. The number of transistors used to create the chip is actually impressive: 6 billion. But sure, we're talking not only about numbers, but about production capacity and architecture. Each Tesla on-board computer will have two AI chips, and chips makes its own assessment of what the car should do next. The computer compares the data, and if they match, the car does what is planned. If the chips “disagree”, the machine analyzes the situation again and tries to find the best solution as fast as possible.

Many of you may know that Tesla has an autopilot system. But how do developers train this system and what methods do they use?

The process isn't the easiest one. If you request random photos, you will get images where, as a rule, the car is driving on the highway – it will be a random data set. If you place only random sets, your network will learn a simple encountered traffic situation (like a straight road) and will work well only in it. When you show it a slightly different example, like an image of a road turning right, your network may give the wrong result. It'll say, “Okay, I've seen it many times, the road goes straight” – and this result is adversed to us, since because

the chance of an accident increases significantly. Therefore, developers take images where the network is wrong and mark them up correctly. Since this process is extremely difficult (due to several points, such as the amount of data that needs to be processed, as well as the human factor), a person needs to apply the maximum amount of attentiveness and concentration for the most accurate training of artificial intelligence on the right route. However, since the process of artificial intelligence training has been going on for more than one year, there is a set of basic templates on the basis of which developers train artificial intelligence to perform more complex maneuvers (sharp turns, driving when skidding or losing traction, sudden braking, followed by avoiding an accident).

An area in which the role of artificial intelligence is extremely high is unmanned drone control. The goal of combining drones and artificial intelligence is to make efficient use of large data sets (for example, aerial photographs) as automated and hassle-free as possible. Drones can reach their full potential only when data collection and analysis reach the highest level of automation. In recent years, the use of complex artificial intelligence algorithms has become possible for drones due to the huge and rapid growth of computing power, as well as the cost of storing and accessing digital data. Most of the applications of machine learning algorithms are currently observed in the field of verification and maintenance. Companies like Sky-Futures and Scopitone use different machine learning approaches for different validation tasks. For example, power line insulators are automatically recognized in images and checked for anomalies, or algorithms are used to detect corrosion on metal surfaces. According to Sky-Futures, their detection rates are extremely high - up to 90 %. Another example is Ardenna, which is currently upgrading software from Computer Vision Software to the machine learning-based BNSF railway inspection company. Many AI methods are already being used for data analysis in the energy, agriculture, real estate, construction and forestry sectors. The list of applications of AI-based data analysis seems endless, and the examples just mentioned are only a small part of what is already available on the market.

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IMPACT OF PRICING IN THE AUTOMOTIVE INDUSTRY ON CONSUMER BEHAVIOR UNDER CONDITIONS OF ECONOMIC INSTABILITY

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Abstract. The major objective of the research is to analyze the impact of pricing in the automotive industry on consumer behavior under conditions of economic instability in the recent period. Consumer preferences and behavior in economic instability are under the influence of pricing strategies during the period of structural changes of the Russian economy, increased inflation and uncontrolled price growth. The study has been designed to improve pricing strategies to adapt it to modern realities. Special attention is paid to the impact of the geopolitical situation and global economic crises on the development of the industry, the formation of new segments in the global automotive industry, as well as on purchasing power. Scenarios of the geopolitical situation impact on cooperation between Russia and foreign countries in the automotive industry are evaluated. Possible options for improving the existing pricing mechanisms aimed at adapting them to modern realities are proposed.

Keywords: consumer behaviour, demand, automotive industry, pricing, transformation, car value creation, costs, automotive parts.

ВЛИЯНИЕ ЦЕНООБРАЗОВАНИЯ В АВТОМОБИЛЬНОЙ ПРОМЫШЛЕННОСТИ НА ПОВЕДЕНИЕ ПОТРЕБИТЕЛЕЙ В УСЛОВИЯХ ЭКОНОМИЧЕСКОЙ НЕСТАБИЛЬНОСТИ

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Аннотация. Основной целью исследования является анализ влияния ценообразования в автомобильной промышленности на поведение потребителей в условиях экономической нестабильности в настоящее время. Потребительские предпочтения и поведение в условиях экономической нестабильности находятся под влиянием стратегий ценообразования в период структурных изменений российской экономики, усиления инфляции и неконтролируемого роста цен. Исследование было разработано с целью совершенствования ценовой стратегии для ее адаптации к современным реалиям. Особое внимание уделяется влиянию

геополитической ситуации и глобальных экономических кризисов на развитие отрасли, формирование новых сегментов в мировой автомобильной промышленности, а также на покупательную способность. Дана оценка сценариев влияния геополитической ситуации на сотрудничество России и зарубежных стран в автомобильной промышленности. Предложены возможные варианты совершенствования существующих механизмов ценообразования, направленные на их адаптацию к современным реалиям.

Ключевые слова: потребительское поведение, спрос, автомобильная промышленность, ценообразование, трансформация, создание стоимости автомобиля, затраты, автомобильные запчасти.

Today our life at this development stage and 5 years ago are two completely different concepts. Life has completely changed, so the changes occurred have affected all spheres of human life and activity. However, it is important to understand that change is an integral part of any industry or business. And an equally important aspect is that without change there will not be any movement and development.

From year to year, we can observe the emergence of new trends. In response to these innovations, organizations are constantly developing, testing, and boldly implementing innovative strategies to solve business issues, which can lead to incorrect operation of systems, failures, shocks, and, as a result, to more global and profound changes, or transformation.

There are many variations of the definition “transformation”, but the main meaning of this process in relation to business and industry is “making fundamental changes in business to achieve organizational goals and improve processes, technologies and productivity” [1].

The current global megatrends that have led to a radical shift in the factors determining the value of a business, the actions of the main players in the business arena, as well as pricing strategies are discussed below. These include:

- 1) Rapid urbanization, demographic and social changes;
- 2) Rapid development in the field of IT and technology;
- 3) Changing global economic power;
- 4) Climate change and resource availability.

Next, an analysis is carried out of how the trends presented above may affect the automotive industry and pricing in the automotive industry:

1) Consumer needs are growing and changing at a high rate, awareness of technological breakthroughs in the automotive industry among developed countries is also growing, as a result companies have to improve their product or service constantly and introduce new ones.

2) The rapid development in IT and technology in the automotive industry has led to technological and digital transformation of entire value chain with the digitalization of everyday operations. Companies focus on the introduction of autonomous vehicles (“autonomous cars”, fully automated cars operated without a driver), connected vehicles (“connected cars”, cars with

integrated intelligent systems providing Internet access) and embedded digital and mobile services.

3) It is expected that India and China will become one of the largest manufacturers of passenger cars and occupy a niche market by 2025, which will lead to an increase in the role of companies in these countries in the value chain of cars.

4) Emissions control, introduced and carefully controlled by regulatory authorities, is carried out in the form of: the norms of GOST R 52033-2003, GOST R 52160-2003, GOST R 41.24-2003, GOST R 54942-2012 authorized on the territory of Russia; the growing number of electric vehicle users (for example, the average annual growth rate of the electric vehicle market in Russia can reach 82 % to 2030); alternative fuels to replace fossil fuels; and increase investments in compliance with regulatory requirements.

5) Russian consumers are becoming less loyal to the traditional model of transport (personal car) and actively use various types of mobility, such as carsharing, car rental, bicycle rental, kicksharing.

Having analyzed the megatrends and their impact on the automotive industry, we can present the conclusions in the following form (Fig.1):



Figure 1. The impact of megatrends on the industry (compiled by the author)

Thus, most companies consider changes in economic conditions (embodied in global megatrends) as an opportunity for innovation and improvement, rather than perceiving them as a threat. Moreover, the long-term phenomena of these global megatrends can significantly affect the supply chain or the factors of creating the value of goods and business [2].

The issue of pricing in any industry is the initial one throughout the entire product life cycle: from the planning process, production and distribution to the final consumer. The reason we include the development process even at the planning stage is that it is important to understand what the cost of the goods is consist of. As a result, the price should not be underestimated or overstated by manufacturers and this will not affect consumer behavior and business profitability negatively. Thus, pricing should be an integral part of the product launch plan from the very beginning.

Pricing is the process of setting the price of a good or service. The price should include all costs and expenses for development, production, testing, moving (transportation), storage pending subsequent processing (warehousing), control and sale of goods to generate the profit necessary to maintain and

improve the business, brand positioning, as well as increase the welfare of stakeholders (most often shareholders) [3]. Thus, the price can be called the monetary expression of the value of the product, which includes all costs incurred during the entire life cycle of the product or service, as well as value added. And it is the price that can be described as an instrument involved in establishing an equilibrium between supply and demand.

Today, it is necessary to consider the conditions of economic uncertainty that are developing, which will inevitably affect prices and, accordingly, consumer purchasing power. During such periods, organizations need to improve existing approaches and tools applied in pricing and involve mechanisms of price adaptation, which will provide an opportunity to calmly respond to changing business conditions and adapt to a changing market situation.

According to the Strategy for the Development of the Automotive Industry of the Russian Federation approved in April 2018 by the Ministry of Industry and Trade for the period up to 2025, the Russian automotive industry is at a fairly high level of production concentration and represents a wide range of cars for sale, including such production segments as passenger cars, light commercial vehicles, trucks, and buses. And as mentioned earlier, the process of automotive manufacturing and pricing has remained virtually unchanged over the past decades.

However, it is important to take into account the fact that the current geopolitical situation in the world dictates absolutely new conditions and strategies that modern automakers have to develop and implement. Only the factors that make up the cost of the car remain relatively unchanged, but the indicators and the quantitative ratio of these factors can be completely different from year to year and for each individual manufacturer.

Analyzing the process of creating the car value of some well-known companies operating in Russia, the following distribution can be made: the cost of components until 2022 was 10 %, the next 10-15 % included the cost of assembling the car. The next point is the costs of development, maintenance of research institutes, production defects and warranty cases, which also account for 25 % of the price. In total, we have 50 % of the cost, which is invested directly at the factory in a specific model. Further expenses include up to 20 % for promotion (marketing), crash tests, exhibitions, concepts, advertising through various distribution channels. The remaining 30 % of the cost of the car can be distributed differently depending on the goals of the company itself: someone attributes this share to marketing, other companies go to cover their debt or other items of expenditure. Thus, we came to the full cost of the car.

Total of 1.667 thousand cars were sold (with a positive dynamics of 4.2 % relative to 2020), this number includes cars of domestic brands, foreign cars of Russian production and imported cars.

However, given that most of the cars are manufactured in Russia, many components are purchased in foreign countries, which directly affect the amount of costs per car. This problem is especially relevant today, when every day more

and more auto brands that occupy the main percentage of the market and spare parts suppliers stop or freeze their activities in Russia. In addition, it is important to take into account other factors that influence such an outcome of events. These include a sharp drop in the ruble exchange rate, uncertainty about the prospects of working in the Russian market and problems with logistics [4].

According to experts, all of the above factors have led to an increase in the price of components by an average of 30 % (this also includes an increase in the cost of transporting spare parts). We can also observe an increase in the cost of loans, where car loans are no exception.

Despite the increase in interest rates on car loans after the cancellation of subsidies in January 2018, sales on credit remained at the same level as the previous year until 2021. However, comparing the number of car loans issued in January 2022 (59.7 thousand car loans) with the data of the same period of previous years, we can conclude that this number is the smallest since the "quarantine" May 2020 (42.9 thousand units), and moreover decreased by 11.1 % compared to January 2021 (67.2 thousand units). In turn, compared to the previous month, the number of car loans issued decreased by 25 % (in December 2021 – 79.6 thousand units).

It can be concluded that according to the impact of mentioned factors on the automotive industry (a rapid rise in prices as a result of the rise in the cost of components, fluctuations in the ruble exchange rate, an increase in the interest rate on car loans, the termination of the activities of many car brands in Russia), consumer behavior is also changing, therefore, sales are expected to decline by 3-5 % in 2022.

The implementation of the forecast will depend mainly on whether the geopolitical situation in the world will improve, and, consequently, whether the disruption in the global supply chains of components will be eliminated, whether the previous level of solvency of the population will return, whether state support measures will be applied.

It was mentioned above that today electric vehicles and the transformation of the traditional format of using a car are gaining more and more popularity. Russian companies such as Yandex SDG, KAMAZ, MADI, Starline, Alliance "Technical Vision", SberAutoTech are actively developing the technologies necessary to create connected and self-driving cars, so one of my recommendations is to consider a possible partial transition of the Russian automotive industry and focus on upgraded models, as well as actively use various types of mobility.

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COMPARATIVE ANALYSIS OF COSTS AND BENEFITS OF TOKAMAK DEVICE

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Abstract. This article discusses the analysis of the materials cost for the construction of a tokamak plant. As a result of the analysis, long-term use profitability of this facility construction will be summed up.

Keywords: tokamak, magnetic field, cost of materials, lithium, steel, thermonuclear fusion.

СРАВНИТЕЛЬНЫЙ АНАЛИЗ ЗАТРАТ И ВЫГОД УСТАНОВКИ ТОКАМАК

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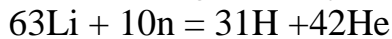
Аннотация. В данной статье рассматривается анализ стоимости материалов для строительства установки токамак. В результате анализа представлена рентабельность строительства этого объекта для использования в долгосрочной перспективе.

Ключевые слова: токамак, магнитное поле, стоимость материалов, литий, сталь, термоядерный синтез.

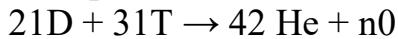
Tokamak (Figure 1) is a torus-shaped construction designed to carry out controlled thermonuclear fusion of heavier atomic nuclei from lighter ones in order to generate energy [1]. Unlike thermonuclear explosive devices, such as a hydrogen bomb, tokamak uses the process of slow heating of the initial substances to the state of plasma, the most popular substance in the universe. Energy is obtained from it, which is later converted into electric current through complex of technical tasks. For such controlled thermonuclear fusion to occur, two conditions must be met:

- 1) carrying out the reaction of deuterium and tritium synthesis (D-T fuel);
- 2) high temperatures, over 10^9 K.

In contrast to oil, gas, uranium ores and other exhaustible resources, reserves deuterium and tritium are practically unlimited: one is produced on an industrial scale from the water of the World Ocean, and the other is extracted from lithium through a fairly simple reaction [2].



(1) – production of tritium from lithium



(2) – production of helium through the synthesis of deuterium and tritium.

The plasma is confined by the ring-shaped toroidal and poloidal magnetic fields in a vacuum vessel that has the shape of a toroid. An appropriate coolant, the helium gas and/or a eutectic alloy liquid flowing in the blanket modules through the vacuum vessel close to plasma, extract the heat from the fusion. The heat is transported to the coolant through the walls of the TBMs by both radiation from plasma and the electrically neutral 14.1 MeV neutrons that escape from the plasma into walls and functional materials.

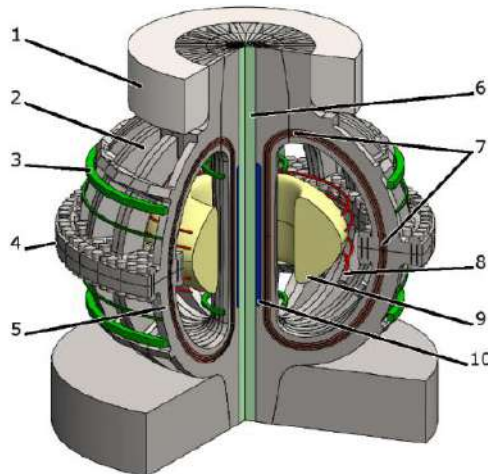


Figure 1. Tokamak construction schematic: 1 – power ring; 2, 5 – power toroidal ribs; 3 – poloidal superconducting coil; 4 – connector of toroidal ribs and coils; 7 – toroidal conductors; 8 – correcting poloidal coils; 9 – plasma volume; 10 – central inductor

The analysis of tokamak objects in combination with neutron transfer calculations makes it possible to consider not only physical and technical limitations of plasma, but also the limitations of neutrons. Such an analysis can play a key role in determining the parameters of a self-consistent system and the optimal design of a Tokamak at minimal cost.

For the construction of a tokamak a number of stable materials are required – both structural and functional. Since it must withstand high-energy neutrons with an energy of 14.1 MeV generated as a result of the fusion of deuterium and tritium in a tokamak, structural materials must have radiation resistance among other properties, and functional materials must have the required level of integrity.

An optimum reactor building is composed of multiple components:

1. magnetic system: holds deuterium-tritium fuel in the form of plasma and in the form of a torus;
2. field coils
3. vacuum vessel – contains nuclear fusion plasma and maintains fusion conditions;
4. blanket – capture of high-energy neutrons formed during a thermonuclear reaction;
5. first wall – located between the plasma and magnets to protect the external components of the vessel from radiation damage;
6. cooling system – removes heat from the confinement and transfers heat from the first wall;
7. diverter – it is used to extract impurities from the plasma that get there from the “hot wall” of the blanket.

Table 1 – Characteristics of the main magnets

	<i>Conductor material</i>	<i>Cost million €</i>	<i>Stored energy, GJ</i>
Poloidal field – PF	NbTi	4	122
Toroidal field – TF	Nb ₃ Sn	41	323
Central solenoid – CS	Nb ₃ Sn	6,4	135

As mentioned in the article by I. V. Kurchatov About the possibility of creating magnetic thermonuclear reactors the main components of most tokamak parts consist of stainless steel. The per-screen, made of ferritic-martensitic steel (FMS) and filled with tungsten carbide, is cooled with water. The requirements for the plasma coating material for the TF superconducting coil include a fast neutron flux for a superconductor of less than 10^{19} n/cm², a nuclear heating rate for a package of windings of less than 1 MW/cm³, radiation damage to a copper stabilizer of less than 5.0×10^{-4} dpa and a maximum absorbed radiation dose using an organic insulator of 1.0×10^9 rad. Lithium-lead blanket is considered as a coating. A layer of 90 % enriched ⁶Li is used as a neutron breeding material, neutron multiplier and coolant. As a structural material, FMS reinforced with oxide dispersion is used, with a flow channel insert made of SiC. With a fixed thickness of the outer layer, the thickness of the inner layer was determined in accordance with the requirement for tritium self-sufficiency, which was assumed to be equal to TBR > 1.35. This value gives a TBR > 1.08 in three-dimensional geometry, assuming that the coating covers 80 % of the plasma surface. Tungsten was used as the armor material for the first wall [3].

Table 2 – Approximate costs used to calculate costs

<i>Component</i>	<i>Approximate costs</i>
First wall	6·10 ⁴ USD/m ²
Divertor	6·10 ⁵ USD/m ²
Blanket	20 USD/kg for PbLi 90 USD/kg for FMS structure 100 USD/kg for SCI insert
Shield	40 USD/kg
TF coil	2·10 ³ \$/m
PF coil	0.02 USD/(A·m·T)
CS	1·10 ³ USD/m
Case	50 USD/kg

The cost of electricity for thermonuclear power plants using various superconductors in coils varies from 10.1 for modern materials to 20.9-euro cents for tokamaks with a useful electrical capacity of 500 MW, 1000 MW and/or 1500 MW [4].

The problem of materials is the second most important problem, after plasma ignition and its maintenance, which needs to be solved for the commercial use of thermonuclear energy using tokamaks. To do this, it is necessary to first develop materials that are used in the construction of a tokamak, with characteristics and service life that are desirable for their use in a tokamak environment. Li must be enriched to Li⁶, followed by the production of lithium ceramic pebbles with the desired characteristics both as individual pebbles and in combination. The same applies to beryllium and beryllium pebbles, which are necessary for solid-ceramic breeding modules with helium cooling. The desired low activation of the F/M steel should be achieved by further refining the steel. It is necessary to solve the problem of coatings that would reduce the resistance of MHD without corrosion or erosion by the flow of high-temperature liquid refrigerant. In addition, the unknown domain of the behavior of all these materials and their compounds in the medium of thermonuclear neutron fusion with an energy of 14.1 MeV should be investigated both theoretically and experimentally, as far as possible, using the current level of knowledge in this field and available radiation sources.

There are also devices similar to a tokamak, consisting of the same materials, but in general taking up less space. A large spiral device is a stellarator. They show good results in plasma retention, not inferior to other large thermonuclear devices. They can reach an ion temperature of 13.5 keV (about 160 million degrees) and a stored plasma energy of 1.44 million joules (MJ), and at a cost of much less cost, about 1 billion euros. The stellarator device is much more profitable than a tokamak in terms of construction and

maintenance, as well as the cost of electricity, but it gives much less energy and holds plasma for a small amount of time, unlike a tokamak.

With a general calculation of the costs of building and equipping a tokamak and generating energy, on average, it takes from \$1.5 million to \$12 billion, depending on the size of the toroidal coils and the overall installation system. Which, on average, is not cost-effective, because even with long-term use of the installation, the energy benefit from it is imaginary not counting the additional costs of maintaining the entire system in integrity and waste disposal.

The estimated decommissioning costs will not fully reflect the potential costs a commercial power plant generating electricity.

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A DESIGN OF A HIGH-SPEED MARINE EQUIPMENT CARRIER

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Abstract. This paper provides basic information on a project of a new vessel which is being designed for emergency oil spills response as well as assistance in underwater pipeline damage elimination. The work specifies the main dimensions of the vessel primarily based on the analysis of the pipelines' hydrologic and geographic data.

Keywords: catamaran, underwater vehicle, floating booms, emergency oil spill, pipeline damage, foiling vessel.

ПРОЕКТ СКОРОСТНОГО СУДНА-НОСИТЕЛЯ ОБОРУДОВАНИЯ

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Аннотация. В работе приведена базовая информация по проекту нового судна, разрабатываемого для операций ликвидации аварийных разливов нефти и участия в борьбе с повреждениями подводных трубопроводов. Определяются главные размерения судна, первоначально основанные на анализе гидрологических и географических параметров трубопроводов.

Ключевые слова: катамаран, подводный аппарат, боновые ограждения, аварийный разлив нефти, повреждение трубопровода, судно на подводных крыльях.

The emergency oil spills are a serious problem that goes hand in hand with transportation of both cargo and people. These can be a result of oil cargo losses as well as fuel spills. According to the data provided by Rosprirodnadzor, in the year 2018 3053 cases of accident oil spills that covered the surface of 2.145 km² were registered in Russia; in 2019 there were 819 cases; 2020 and 2021 counted respectively 49 and 32 oil spills [1].

Basing on this data we can affirm that the danger of oil spills has declined significantly. However, they still cannot be totally avoided since even the most well-developed means of protection are vulnerable to unforeseen situations.

Water transport has the largest cargo turnover out of all existing modes of transport. Thus, the vulnerability to oil spills is also predominant. In the same time, marine oil spills are more dangerous than onshore ones since oil, spread by currents and waves, can cover dozens of square kilometres of water. The combination of these factors makes us pay most attention to the ecological safety of the marine areas, including accident oil spills elimination.

The most important stage in the operation of eliminating a spill is the localisation of the oil slick. It is done by installing a barrier of floating booms around the polluted area. The sooner it is done, the smaller area would be covered by oil, the faster and easier will it be eliminated from the surface and the less dangerous will the accident become for the environment. After the slick is localized the oil film is removed from the surface by various chemical and physical methods.

The vessel

Therefore, there is a need for a vessel that would ensure fast and efficient restriction of the oil spread by the time the skimmers reach the location of the spill. Apart from the floating booms it should carry autonomous underwater vehicles that would assist in finding the location of the pipeline damage, provide information about the possible ways of repair, and, in less serious cases, take steps towards the repair itself.

Firstly, the type of the vessel needs to be defined. It should be fast, have good seaworthiness, and be able to operate its cargo quickly. The most logical solution seems to be a catamaran. The equipment it carries can be put in the water between its hulls and thus protected from the waves and operated quickly and easily, without the use of complicated crane systems. Moreover, the catamaran can be upgraded with a system of hydrofoils which will reduce drag and fuel consumption.

Today the foiling catamaran concepts are becoming more popular in the sphere of passenger shipping. There are still no designs of these vessels that would be used for special purposes, such as oil spill response.

The requirements

To evaluate the cargo capacity of the vessel some of the foreign autonomous underwater vehicles were analysed. The mass of the vehicles varies between 50 and 1130 kg [2]. However, expecting the vehicle to be able to carry out not only inspections but also underwater repairs, we can assume the mass as of 1 tonne and speed 5 kn.

To evaluate the quantity of the vehicles carried on board we need to analyse the pipelines, limiting the list to the ones located or starting in Russia. The longest oil pipeline has the length of 70 km (Filanovskogo Field, the Caspian Sea) and ends onshore. The longest gas pipeline has the length of 1234 km (Nord Stream 2, the Baltic Sea), and the furthest distance from the shore is 220 km (TurkStream, the Black Sea) [3].

The regulations require the emergency oil spill to be localized within 4 hours from the moment of its detection. The vessel that is being designed is therefore meant to submerge the underwater vehicles that will inspect the

pipeline, find the damage and, if possible, begin the repairs. Meanwhile the vessel will install the floating booms, restricting the spill on the surface.

As the speed of the underwater vehicle is 5 kn (9.3 km/h), 4 hours of inspection will cover just under 40 km of the pipeline. Therefore, no less than 2 vehicles are necessary. Keeping in mind that additional time is needed for localizing the spill, 3 vehicles shall be carried on the catamaran.

This way the mass of the necessary underwater vehicles will be 3 tonnes, but the cargo capacity shall be 5 tonnes, as there will also be additional cargo such as floating booms, measuring equipment etc.

The crew needed for operating the vessel will be 2-3 people but supposing that the oil spill elimination could last for more than a day, the watch method will be used and the quantity of crew increases up to 4-5 people. In addition, there shall be space for 2 people not related directly to the navigation (such as scientists). Thus, the total number of people on board will be up to 7.

The operating speed of the vessel will be primarily evaluated as 30 kn minimum, as an analysis of the built foiling vessel designs shows [4]. It can change as a result of the calculations.

The vessel endurance will be 5 days. This evaluation contains a significant reserve, since remembering that the distance to the shore is no more than 220 km (120 miles), the time to get to a shelter will not be greater than 4-6 hours. Nevertheless, we need to bear in mind that the operation might face certain difficulties, such as bad weather or technical problems, which may not allow the catamaran to leave the location of the spill.

The starting point

As the vessel has no prototypes, we need a starting point for the calculations. This will be the displacement of the vessel evaluated basing on the statistics of the built designs [4]. We shall consider no less than ten designs with the displacement of 15-35 tonnes.

Basing on the data above, the displacement values of the vessel unloaded D_{min} and D_{max} can be estimated:

$$D_{min} = 5/0,27 = 18,5 t$$

$$D_{max} = 5/0,19 = 26,3 t$$

Now we can evaluate the engine capacity basing on the analyse of the vessel designs that have the displacement of 18.5-26.3 tonnes [4].

As we still do not know exactly the displacement of the catamaran, we can evaluate the engine capacity needed as 1000-1100 kWt. We also need to keep in mind that this capacity shall be divided in 2 as each hull of the catamaran will carry one engine.

One of the manufacturers and providers of vessel engines, such as “Volzhskiy Diesel’ imeni Maminykh” gives us a variety of engines that are close to our requirements. Therefore, the theoretical engine we choose will have the following parameters:

Table 1 – The theoretical engine

<i>Model</i>	<i>N</i> (kWt)	<i>Rotation</i> <i>rate</i> (1/min)	<i>L×W×H</i> (mm)	<i>Max. fuel</i> <i>consumption</i> (g/kWt-h)	<i>Max. oil</i> <i>consumption</i> (g/kWt-h)
Theoretical engine	520	1800	2000×1300×1700	200	1

Now we can calculate the fuel consumption for the cruising speed:

$$2 \cdot 520 \text{ kWt} \cdot 0,2 \text{ kg/kWt} \cdot h = 208 \text{ kg/h}$$

Obviously, the catamaran will not have the cruising speed during all the 5 days of its endurance. Therefore, it will have a slow-speed regime. The engine capacity for this regime will also be evaluated from the analysis of the built foiling [4] and make 100 kWt-h.

The oil consumption will therefore make 120 kg = 0,12 t.

The displacement formula is:

$$D = \frac{P_{dw}}{\mu}$$

Where D is displacement, P_{dw} – deadweight, μ – deadweight coefficient = 0,320.

$$P_{dw} = P_{cargo} + P_{crew} + P_{fuel}.$$

While:

$$P_{fuel} = 0,12 \tau + mQt = 0,12 + 1,1 \cdot [0,208t + 0,01(120 - t)]$$

Where m is the overpower fuel coefficient; Q – fuel consumption; t – possible cruising speed time to guarantee the autonomy time. Therefore:

$$0,32D = 5 + 0,15 \cdot 7 + 0,12 + 1,1 \cdot [0,208t + 0,01(120 - t)]$$

$$D = 23,41 + 0,66t$$

To find the displacement we need to specify the time that the vessel needs to be able to keep the cruising speed.

As the maximum length of a pipeline that needs to be inspected is 70 km, it will be passed by during 1.5 h and passing both ways will take 3 h. Still, passing along the pipeline should be available 4 times, which makes 6 h. The possible time spent for travelling from the harbour can be evaluated as 2 h, so both ways makes 4 h. Therefore, the total time shall be 10 h, IE $t = 10$ h

Inserting $t = 10$ h into the formula:

$$D = 23,41 + 0,66 \cdot 10 = 30,0 \text{ t}$$

So, we have specified the displacement $D = 30,0$ t; deadweight $P_{dw} = 9,6$ t; $t = 10$ h.

Specifying the main dimensions

Basing on the deadweight and displacement values we can utilize the known equations [5, 6, 7] and define the main dimensions of the vessel.

The density of water ρ is 1.025 t/m³. The coefficient of protruding parts k is taken as 1.1.

Table 2 – The main parameters of the catamaran

<i>Parameter</i>	<i>Marking</i>	<i>Formula</i>	<i>Value</i>
Cruising speed	v	-	30 kn
Initial engines' capacity	N	-	1040 kWt
Displacement unloaded	Mass	D	30,0 t
	Volume	V	D/ρ 29,27 m ³
Length	Maximum	L_{max}	$13,3 \cdot P_{rp}^{0,34}$ 23,0 m
	Waterline	L	$L/L_{max} = 0,9$ 20,7 m
Width	Hull	B'	$B' = 0,0344L_{max} + 1,5722$ 2,2 m
	Maximum	B_{max}	$0,2424L_{max} + 1,9836 \pm 1,1$ 7,58 m
Draught	T	$0,041L_{max} \pm 0,5$ and $\frac{2B'}{T} = 4,4 \div 5,4 \Rightarrow T \leq 1,0$	0,95 m
Height	H	$0,0574 \cdot L_{max} + 1,4323$	2,7525 m
Block coefficient	δ	$\delta = \frac{D}{k\rho LB'T \cdot 2}$	0,3075
Froude number	F_{nV}	$\frac{v}{\sqrt{gV^{1/3}}}$	2,807
Propulsion coefficient	K_0	$-0,8645F_{nV} + 8,0074$	5,581
New engines' capacity, or	N_{new}	$\frac{gDv}{K_0}$	814 kWt
New cruising speed	v_{new}	$\frac{NK_0}{gD}$	19,72 m/s = 38,3 kn

As we can see, the capacity of the chosen engine is too big for the catamaran, so we can either choose a different engine, or increase the operating speed of the vessel. Both changes will have an impact on the dimensions of the design. However, these shall be minor changes, therefore the vessel is still well described by the parameters given in the table.

Thus, the general view of the foiling catamaran could be close to the one on the picture below.



Figure 1. The general view of a foiling catamaran

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DESIGN OF A TAIL ROTOR FOR A LIGHT MULTI-PURPOSE HELICOPTER WITH A TAKE-OFF WEIGHT OF 4000 KG

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Abstract. This paper presents the analysis of the possibility of modernization of light multipurpose helicopter in order to increase its maximum take-off weight from 3600 kg to 4000 kg.

Keywords: helicopter construction, tail rotor, tail rotor hub design, takeoff weight, mass useful-to-takeoff load ratio.

ПРОЕКТИРОВАНИЕ РУЛЕВОГО ВИНТА ЛЕГКОГО МНОГОЦЕЛЕВОГО ВЕРТОЛЕТА ВЗЛЕТНОЙ МАССОЙ 4000 КГ

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Аннотация. В данной работе рассматривается возможность модернизации легкого многоцелевого вертолета с целью увеличения максимальной взлетной массы с 3600 кг до 4000 кг.

Ключевые слова: конструкция вертолета, рулевой винт, проектирование втулки рулевого винта, взлетная масса, массовая отдача по полезной нагрузке.

Increasing the maximum takeoff weight is a promising direction of aircraft modification process, as the higher the takeoff weight, the better the mass payoff is. In turn, the mass useful-to-takeoff load ratio is one of the main indicators allowing to evaluate the efficiency of the aircraft as a means of transportation.

This research work considers the possibility of modernization of light multipurpose helicopter in order to increase its maximum take-off weight from 3600 kg to 4000 kg. Ansat helicopter was chosen as a prototype. The object of modernization is the tail rotor.

The research was completed in a number of steps. First, the review analysis of different tail rotor hub designs on Russian and foreign helicopters

was performed, after what their classification was completed [1]. The following types of designs are considered:

1. Articulated/hinged hub:

- A. Steering propeller hub with a spherical bearing in the axial joint
- B. Steering propeller hub on a common horizontal flapping hinge
- C. Steering propeller hub on gimbal assembly
- D. Steering propeller hub with separate horizontal flapping hinges
- E. X-shaped steering propeller hub

2. Fixed-end/hingeless hub:

- A. Ducted fan (fenestron)
- B. Spheriflex-type steering propeller hub with annular socket/flaring

All the designs were analyzed and the design features of the tail rotor mounting schemes were described, as well as the examples of serial helicopters where these schemes having been implemented were given.

As the takeoff weight of the helicopter increases, the thrust of the main rotor must be increased, which will result in an increase in the reactive torque. To compensate this, it is also necessary to increase the thrust of the tail rotor as well. This can be done in two ways:

- 1. By increasing the diameter of the tail rotor.
- 2. By increasing the number of blades.

The first option is less preferable, as increasing the propeller diameter leads to the risk of the blades colliding in flight, which will inevitably lead to a disaster. To avoid this, it is necessary to either lengthen the tail boom or introduce a tail rotor pylon into the design, which will lead to a significant increase in the original weight of a helicopter (without load).

Based on the review analysis, the configuration with kinematic fixation of the propeller hub on the gimbal assembly was chosen as the most effective and economically reasonable.

The next step was the first approximation design calculation of the helicopter of a given mass which allowed to obtain the following parameters: mass of empty helicopter, mass payoff, mass of commercial load, fuel mass and static ceiling. Also, during the design calculation, the helicopter's balance limit was calculated [2].

In the work, we calculated the flight and technical characteristics, plotted the available and required power at altitudes from 0 to 5 km. Maximum, minimum, critical, economic and cruising speed were determined [3]. As a result of this calculations, it was found out that the helicopter cannot take off vertically as early as 0 m above sea level with an engine throttle ratio of 0.9. However, the helicopter takes off and lands at takeoff mode when the engine throttle rate is 1, where there is the excess of power. The air cushion effect, which was not considered in the calculation, will also contribute to takeoff. Simultaneously with the reduction of the flight characteristics the mass of the commercial load increased from 469 kg to 846 kg.

Next, a preliminary calculation of the tail rotor was carried out, including the following [4; 5]:

1. Calculation of design loads.
2. Calculation of the hub for torsion.
3. Calculation of bolt connection of hub with tail gearbox shaft.
4. Calculation of hub-crosshead splines for bending/buckling/dimpling.
5. Calculation of tapered roller bearing of gimbal assembly.
6. Calculation of spherical blade bearing.
7. Calculation of blade mounting pin.

The next step was creation of an electronic 3D model of the tail rotor hub. Structurally it is a gimbal assembly and a hub shell similar to the design of the Mi-8 tail rotor. But instead of a full-fledged classical axial joint the hub shell has 3 pairs of consoles, located at an angle of 120 degrees to each other. There are holes in the consoles for spherical bearing pins, which act as an axial hinge and allow to change the angle of the blades, by moving the slide (Figure 1).

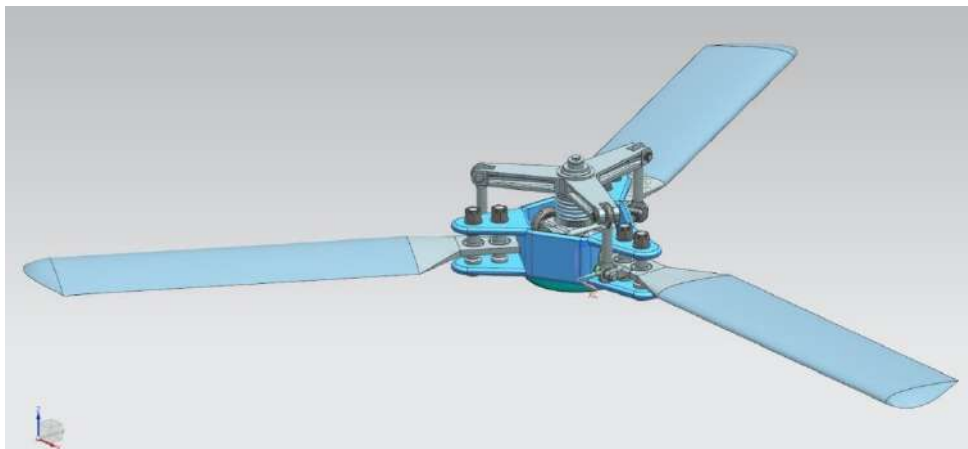


Figure 1. Electronic 3D model of the tail rotor hub

At the final stage of the unit design, the strength analysis of the main parts of the hub was carried out in the Siemens NX software program based on the finite element method.

As the conclusion, the comparison of characteristics of the prototype and the designed helicopter was made (Table 1):

Table 1 – Characteristics of the prototype and the the new-designed helicopter

<i>Parameter</i>	<i>Unit of measurement</i>	<i>Prototype</i>	<i>New design</i>
Take off mass	kg	3600	4000
Maximum speed	km/h	260	275 (H=1000)
Cruising speed	km/h	220	225 (H=1000)
Maimum rate of climb	m/s	12	2,61
Hoover ceiling	m	1340	700
Dynamic ceiling	m	5000	4700
Payload mass	kg	469	846
Useful-to-takeoff load ratio	-	0,318	0,379

As a result, despite the significant reduction in flight performance, the modification of the helicopter looks justified, as it expands its capabilities as a transport vehicle and allows to carry additional commercial load, which will have a positive impact on the profit of the operator.

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DIGITALIZATION OF SMALL AND MEDIUM BUSINESS IN RUSSIA: OPPORTUNITIES AND CHALLENGES

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Abstract. The article outlines the role of digitalization in modern conditions, studies the market for IT and business services by region, presents promising areas of business digitalization, and identifies factors that negatively affect the process of digital transformation.

Keywords: small business digitalization, IT technologies, business process optimization.

ЦИФРОВИЗАЦИЯ МАЛОГО И СРЕДНЕГО БИЗНЕСА РОССИИ: ВОЗМОЖНОСТИ И ПРОБЛЕМЫ

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Аннотация. В статье обозначена роль цифровизации в современных условиях, изучен рынок ИТ- и бизнес-услуг по регионам, представлены перспективные направления цифровизации бизнеса, определены факторы, негативно влияющие на процесс цифровой трансформации.

Ключевые слова: цифровизация малого бизнеса, ИТ-технологии, оптимизация бизнес-процессов.

Small and medium-sized businesses are independent and essential component of a market economy with a high-level importance for the country. Due to small and medium-sized enterprises, conditions – for the development of healthy competition, new workplaces – are created, the introduction of modern technologies is stimulated, which contributes to the growth of labor productivity.

Advances in the field of information technology significantly change the internal environment of the company. Many enterprises on the market tracks

trends in scientific and technological progress and implement them in their business activities, which positively affects their work.

According the report of IDC (October, 2021), the volume of the world IT services market (system integration, consulting and development of custom software, installation and support of the equipment and software, IT-education and trainings) in 2021 will reach a mark of \$1.1 trillion, which is 3.4 % more than a year earlier. In 2023-2024, it will grow by 3.8-4 % annually, and by 4.3 % in the medium term, mainly due to government digitalization programs.

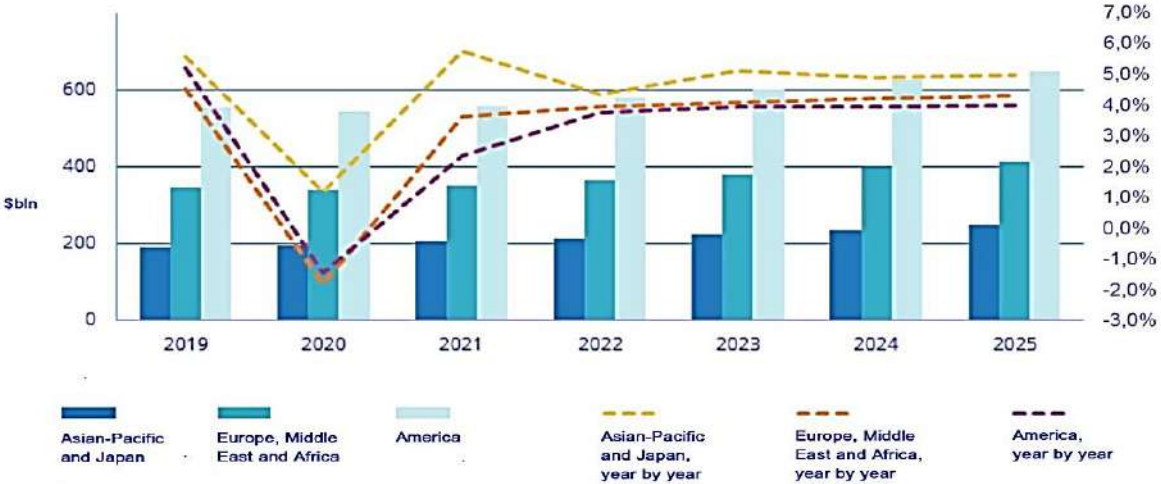


Figure 1. Market of IT and business services by regions, \$bln (forecast)

High demand for IT and business services in countries where large government digitalization programs are being implemented, for example, in Europe and the Asia-Pacific region, became the main driver of global market growth.

Nowadays Russian Federation must reduce the innovation and technological gap from the other countries’ developed economies, improve the administrative environment, strive for the financing availability and reliability for small and medium-sized businesses, develop infrastructure and the service component.

In the current foreign policy situation, characterized by the introduction of sanction packages, the first of which are aimed for restricting the free movement of technologies, issues of development in the information technology industry becomes paramount important. Of course, the new economic reality implies inflationary costs, fall in final demand, an increase cost of financing and a fluctuation in the exchange rate, but it is also an incentive for constant innovation, technologies development and innovation development that will change not only the individual companies’ foundations, but entire industries,

which, in the future, will lead to the emergence of leaders and outsiders in the market among the players [1; 2].

At the moment, Russian companies are looking for ways that can help in their development, create new business approaches, give an advantage over competitors and help optimize costs. Practicality and economy becomes one of the most important features in the face of economic uncertainty.

In the next 3-5 years, the Russian IT services market will grow nearby 4-5 % annually. Especially rise will be noticeable in the client-oriented IT services segment related to solving business problems of customers aimed at creating value and achieving specific business results [3].

The IT market is diverse, it provides a lot of opportunities for new companies. The main reasons of their development are competition and diversity, which contribute to the emergence of ideas, and further – innovations. Customers also benefit from the success of the information market, because competition leads not only to lower price, but also creates products and services that make information technology easier in usage and accessibility.

Modern digital solutions help organizations to be faster and more efficient: they simplify internal work with files, workflow, and management accounting.

Among the priority areas of digitalization following can be marked:

- interactive technologies and digital products;
- machine learning;
- ecosystems;
- projects at the junction of XR.

More advanced information technologies let to make a business more efficient by automating workflow systems, optimizing and digitizing all operations [4]. Here are examples:

1. CRM (customer relationship management system);
2. ERP (production planning, optimization and integration of asset management processes, system resources, human resources and finance);
3. Talantix cloud system (allows you to find solutions for a set of issues related to human resource management: collecting and processing resumes, automating the personnel assessment functions, personnel records management, personnel training and adaptation. This system acts as an alternative to many individual softwares);
4. ECM (documentation support system for the functioning of the enterprise, working with various types, formats and volumes of information).

Today the “smart production” concept is increasingly gaining confidence from large enterprises in various industries around the world, due to the possibility of introducing the industrial Internet of things into their business activities, which combines physical work with innovative digital technologies,

big data and automated (machine) learning. The degree of application of digital technologies in business practices in individual countries varies significantly.

There are also dangers in the process of digital transformation.

If company doesn't have clear and understandable structure, communication lines for employees aren't formalized, processes in such situation becomes difficult to digitize. Standard software solutions will not work. First, the company must make its business processes clear and simple, and then start accelerating them. In the best scenario, if you don't structure business processes, but at the same time accelerate the processes of digitalization, the company's activities will turn out to be chaotic.

Changes in the geopolitical environment, that can limit access to resources necessary for the normal functioning of the company, for example, payment systems.

Lack of appropriate educational programs in the field of IT technologies and, consequently, the lack of qualified employees with the necessary skills.

In addition to the above factors, the mindset of business leaders also have effects to digitalization process. According to the results of an analytical study conducted by RBC together with "Siemens", enterprises faces the following problems [5]:

- possible leakage of company information;
- unclear economic efficiency from projects implementation;
- lack of technical standards and regulations.

In modern conditions, the successful development of the business sector is determined by the use of information technology. They guarantee the competitiveness of representatives from small and medium-sized businesses in the domestic market and also in the external one. The experience of using these technologies in small and medium-sized businesses shows that they are actively used in the fields of construction, logistics, trade, in the field of personnel management, but the range of industries for the use of information technology is not limited, which opens up great prospects for studying this area and improving enterprises' work processes.

So, digitalization implies a change in existing business practices that provide an integrated approach to the application of new technologies in all business processes that take place not only within the company, but also in interacting with the external environment (partners, suppliers, governments and countries).

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ADAPTIVE DESIGN AND MOBILE VERSION OF THE SITE: A COMPARATIVE ANALYSIS

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Abstract. This article discusses the adaptation of the site to mobile devices. The author compares two methods: adaptive design and creating a mobile version separately from the main site. The features of mobile devices, the principles of web and mobile design are reviewed.

Keywords: design, mobile phone, adaptive design, site layout.

АДАПТИВНЫЙ ДИЗАЙН И МОБИЛЬНАЯ ВЕРСИЯ САЙТА: СРАВНИТЕЛЬНЫЙ АНАЛИЗ

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Аннотация. В данной статье рассматривается адаптация сайта к мобильным устройствам. Сравнивается два метода: адаптивный дизайн и создание мобильной версии отдельно от основного сайта. Представлены особенности мобильных устройств, принципы web и мобильного дизайна.

Ключевые слова: дизайн, мобильный телефон, адаптивный дизайн, верстка сайта.

Introduction

To date, the number of Internet users in the world has reached 4.95 billion, which is 62.5 % of the total world population. More than two thirds of the world's population use mobile phones and tablets [1]. Access to the Network is becoming easier every year – the coverage area of networks is expanding, and the data transfer rate is constantly growing. People's interest in mobile

applications, games, websites and other Internet features is growing continuously.

But a lot has changed since the advent of the first computers and smartphones. A huge number of different devices with different technical characteristics appeared. This fact is an important condition for companies that have their own website on the Web. Today, for optimal business performance, it is necessary that the site be easy to use from various devices.

There are several technologies for adapting a site to mobile traffic. The most common of them: creating a separate mobile version of the site and adaptive design. The first approach involves the additional creation of a mobile version of the main site and its location on a separate domain name. This version is distinguished by the presence of its own functionality, designed for a small design screen. Responsive design involves the use of a special page layout. Such a page adjusts itself to the user's screen, which facilitates the work.

Both of these approaches have both advantages and disadvantages. A detailed examination of each will reveal them.

Mobile version of the site

The mobile version of the site has its own characteristics related to design and usability.

The design of the mobile site, of course, is created taking into account the design of the main site and corporate identity. The structure of the site should be designed in such a way that a person using the mobile version can easily work on the main version.

On the other hand, the weight of site design elements should be taken into account in order to avoid loss of quality and traffic overload. Elements should be comfortable, and page space should be sparse.

When creating such a version of the site, the developer also comes with guidelines (methodological recommendations) from various platforms. For the most part, this applies to mobile devices, since they in most cases have a touch screen. It should be convenient for a person to press buttons, otherwise he will quickly close the site. So, in the iOS Human Interface Guidelines, Apple recommends that the size of the clickable area be 44x44 points. This company uses points rather than pixels in its Guidelines because the screens of different devices have different resolutions [2].

The relevance of the mobile version of the site today is difficult to underestimate, since it has many advantages:

1. The amount of memory that the mobile version of the site takes is usually minimal, so the mobile site loads much faster than a regular site;
2. The functionality of the mobile site works properly, unlike the functionality of a regular site viewed on a mobile device;
3. The mobile site has additional functionality. For example, instant messaging, geolocation, and more;
4. The mobile version of the site is adapted to the control of the phone keys and touch-screen technology;

5. Using the mobile version of the site significantly saves traffic and time [3].

Responsive website design

Responsive design is a layout method in which the width of the layout is transformed to the width of the device, which ensures a successful experience on various devices. This concept was first used by Ethan Marcotte in 2010 [4]. He combined flexible grid-based layout, flexible images, and media queries into one unified approach, which he called responsive web design.

The principle of fluid grids is put in the basis of the “flexible” layout. The idea of a “flexible” or “fluid” layout is that the layout uses relative values instead of absolute values, i. e. values are given in percentage and “em”. Using this method, the block width in percent is found using the following formula: $\text{block width (\%)} = \text{block width (px)} / \text{layout width (px)}$ [5].

The principle of “flexibility” images is that the property {max-width: 100 % } must be applied to the image. So, the images will not go beyond the parent block, even if they exceed its dimensions. The same approach applies to videos, flash embeds, and other multimedia objects.

Media queries are part of the CSS standard, which allows you to apply styles based on information about screen resolution, browser height and width, spatial orientation, and device capabilities. Media queries, based on the values of the parameters, allow you to determine how and what information to place. For example, in the case of a small screen, you need to place all the elements so that they fit and are readable by the user. On a large screen, it is necessary to maintain optimal distances, to avoid “holes”.

On the other hand, the development of technologies allows the designer to use ready-made, proven frameworks – platforms, libraries, collections of certain rules. Frameworks are created to simplify the work of the layout designer, to eliminate the maximum possible number of layout errors. However, they also have some disadvantages:

1. Code redundancy (as a rule, only part of the framework is used during work);
2. The need to study the syntax of the framework;
3. External similarity of sites on the same framework.

For the convenience of choosing a framework, there is a classification by tasks and sizes. Backend Frameworks are web development frameworks that run on the server side. They are responsible for separate, but not critical parts. Such frameworks do not allow you to create a site with an interesting, rich interface. They are limited in their functionality, so they are used to create simple pages. Most often they are used in the program-administrative part.

Front-end Frameworks are responsible for the appearance, the client side of the site. The front-end developer is directly involved in an interesting and convenient website template, its user interface. As a rule, such developers use their own frameworks, developed based on their experience.

There are also full stack frameworks that are capable of solving problems on both the server and client sides. A feature of such frameworks is “real time mode” – changes in one interface lead to changes in the others [6].

There are several types of responsive layouts. The most popular of them are rubber, block transfer, layout switching and panels. A fluid layout is blocks that shrink in width to the size of a given device. In this layout, the blocks themselves are rebuilt if they do not have enough space on the page (Figure 1).

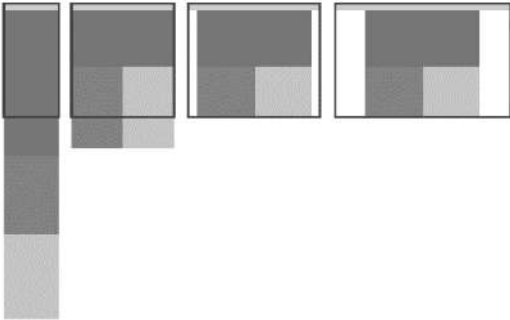


Figure 1. Rubber site layout

Block wrapping is very similar to Fluid Layout, but it is suitable if the site has a multi-column structure. When the screen width decreases, additional blocks (sidebars) in this case are transferred to the bottom of the layout (Figure 2).

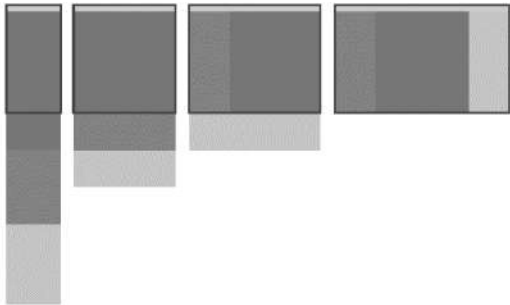


Figure 2. Moving blocks in the site layout

Switching layouts is more labor intensive. It implies a separate layout for each site resolution. Panels are a way that came from mobile layout. In this case, an additional menu appears with a horizontal or vertical tap. Such a site becomes similar to a mobile application. It becomes difficult for the user to work with such a layout (Figure 3).

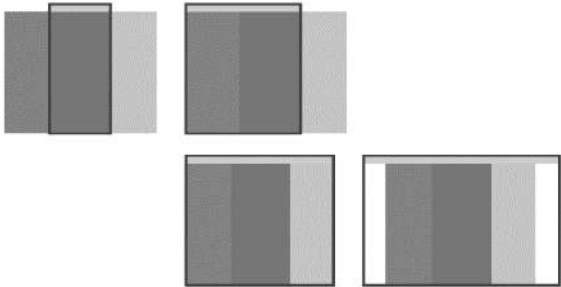


Figure 3. Panels in the site layout

The main goal of responsive design is to create web pages that adapt to the screen size of the user's device and display appropriate content for the best user experience. This design allows the site to be more successful, popular with the user, because it takes into account the requirements and wishes of people.

Thus, the adaptive version of the site is a cheaper and easier option. However, such a site is less user-friendly because the designer did not think separately about usability for the small screen. The mobile version is a more expensive, long-term option to create. This option is suitable for multi-page, complex sites, as they require separate development of elements.

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INFORMATION MANAGEMENT TECHNOLOGIES IN THE FIELD OF TRANSPORT

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Abstract. The article considers the optimal formation of control actions, for which it is necessary to have access to information data about the controlled object. For example, when storing goods in a warehouse, correct identification of goods becomes important. The warehouse needs to receive goods, properly account for them and send them in a timely manner to their destination. The occurrence of one error will lead to the emergence of others. When entering data manually, a person almost always makes at least one mistake. This means that if you automate the data entry of goods and vehicles, it significantly increases the reliability of the warehousing and transportation system.

Keywords: information, management, information technology, transport.

ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ УПРАВЛЕНИЯ В ТРАНСПОРТНОЙ СФЕРЕ

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Аннотация. В статье рассматривается оптимальное формирование управляющего воздействия, для которого необходимо иметь доступ к информационным данным об управляемом объекте. К примеру, при хранении товаров на складе важную роль приобретает правильная их идентификация. Складу необходимо принимать товары, правильно вести их учет и своевременно отправлять по назначению. Возникновение одной ошибки приведет к появлению других. При ручном вводе данных человек практически всегда делает хотя одну ошибку. Это означает, что если автоматизировать ввод данных о товарах и транспортных средствах, то это существенно повышает надежность функционирования системы складирования и транспортировки.

Ключевые слова: информация, управление, информационные технологии, транспорт.

In the modern world, transport management [1, p. 22] is described by the use of information and automated systems. Also, information technology is widely used for transport management. An urgent problem is the need to improve transport management [2, p. 21]. Information technology management in the transport sector includes the management of transport infrastructure. In the modern world, management information technologies are one of the most important means of improving the efficiency of transport management. They turn into intelligent control technologies, and are also the basis for the formation of intelligent control. All this needs constant analysis, which can exist on the basis of existing information management technologies in the transport sector.

Materials and methods

The study used the existing descriptions of information technologies, management technologies and information management. System analysis, structural analysis and spatial analysis were used as methods.

Diversification of information technologies and management methods

Information management technologies in various directions have a large number of forms of implementation. It is necessary to distinguish between the use of three information components in management: information systems [3, p. 29], information technologies and information models in transport management. Information technology reflects the technological aspect. Information systems contain a technological component of management. Information methods include conceptual, logical and methodological aspects of management. The use of information management technologies has a large number of implementations that solve applied problems. The problem of the rational use of information approaches, methods and technologies in the interests of the management and development of socio-economic systems is relevant [4, p. 220]. In reality, there are various information management technologies based on special software tools. This control is problem-oriented [5, p. 40] and is tied to software. A necessary component of information management technologies is the creation of an environment for combining different types of technologies and methods into one system.

Information approach

It is used in many areas, includes system, technological and descriptive characteristics. In the system understanding, the information approach includes: the use of information technologies, the formation of information about the world, the analysis of this data, the construction of information models, the use of information models for solving applied problems. The information approach is also the basis for modeling in information management technologies. The widespread use of information management technologies arose with the

discovery of a new information environment. This environment creates new relationships in society, which are called information relations [6, p. 14]. It is this environment that creates the possibility of integrating technologies into a single technological management complex. The information approach as a base for management information technologies includes: integration of data and technologies, information analysis of processes and technologies, information description of the management object, information description of the structure of management flows, building information models, information modeling. Information modeling in management is used: conceptual, technological, operational levels. Management information technologies contain and need network technologies. The main components of management information technologies are: information, information need [7], information resources, information models. Mankind needs various types of information products and services. This leads to new information needs, which are the need to obtain information goods and services for the life and development of society. So, they create a multi-level hierarchy.

Information Management Models

In information technology, information models are necessarily used. They are divided into two groups: descriptive and prescriptive [8, p. 15]. Descriptive contain functions of descriptions of objects, processes, technologies. Prescriptive models are functions that prescribe certain actions. A feature of the information model is that it serves as a component of interaction and accounting in databases, an analysis component in analysis systems. The value of information models in management technologies is that different information models are used in technologies and information management. The principle of temporal correspondence requires that the control cycle time does not exceed the time allowed to control a given object. Thus, the control cycle time should not exceed the time required to achieve the subgoal. This is called the match time. Also, the time of the control cycle should not exceed the time of a significant change in the state of the control object. For resource matching, it is necessary that information management technology use the real resources that the management system has. The principle of control cycles is that the real control technology should be divided into control cycles. The control loop ends when the goal is reached. The management cycle of the transport sector requires preliminary formation of the time parameters of the management process [9, p. 143].

Conclusion

Thanks to transport management information technologies, the issue of “big data” is reduced. They increase the speed of decision-making, combine different types of data into a single environment. Management information technology contains a large number of management support technologies. The

use of information management technologies is the most important factor in the development of transport management. Such management support includes not only information management technologies, but also technologies for retraining specialists. The use of information management technologies gives regularity in transport management.

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VR APPLICATION IN MEDICINE

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Abstract. The paper gives a review of the ways of using virtual reality technologies in medical field. The existing programs as well the programs under development are discussed.

Keywords: virtual reality, medicine, technology, models.

ПРИМЕНЕНИЕ VR В МЕДИЦИНЕ

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Аннотация. В статье дается обзор вариантов использования технологий виртуальной реальности в области медицины. Приводятся примеры как существующих программ, так и программ, находящихся в разработке.

Ключевые слова: виртуальная реальность, медицина, технологии, моделирование.

Virtual reality (VR) is the term used to describe technology that allows one to interact with virtual “digital” worlds. With virtual reality, hardware developers create experiences in the real world that immerse us in the virtual world. The difference with augmented reality (AR) is that real objects completely disappear from view, the user sees only the virtual environment. VR is the creation of a simple and accessible technology to achieve the effect of full presence [1].

Virtual and augmented reality is used in many areas: in sports, education, movie making, media, culture and tourism, industry, etc. Virtual reality is effective, safe and controllable. This sphere is especially developed in medicine in the following fields:

- treatment of arachnophobia, agoraphobia and other phobias;
- treatment of PTSD (Post Traumatic Stress Disorder), alcoholism;

- assistance in communication for people with autism, Alzheimer's disease;
- online broadcasting for training;
- anesthesiology (anxiety and pain reduction);
- rehabilitation.

In 1997, VR was first used in a project called Virtual Vietnam, which was designed to treat PTSD in war veterans [2]. The project itself is the creation of an environment in which the level of stimuli (such as helicopter flights and the sound of gunshots) is controlled by doctors, thus helping a person to learn how to control their attacks. In 2010, the rise of virtual reality technology occurred.

Currently there is an active testing of virtual reality technologies. Psious VR Therapy online platform provides academic psychotherapists with tools to deal with different types of phobias, eating disorders, depression and PTSD. Psious has developed environments, such as mountains, to create a sense of openness, to facilitate mitigation of negative affect [3].

Virtual reality is also used as a training method for novice surgeons. For example, Onkos Surgical uses VR in surgeries to remove complex bone and muscle tumors. The software, which is installed on one of the compatible VR headsets, projects 3D models of the patient's organs into the surgeon's field of view, allowing him or her to view the behavior of the tissues under the skin [4].

Another company, Total Vision, has developed a helmet to identify "blind spots" associated with visual impairment. The patient has to respond to a signal that appears in different parts of the field of vision. The computer inside the device analyzes the patient's reactions and produces a map of retinal impairment [5].

Virtual reality is also being used in learning. ImmersiveTouch is a leading platform that converts 2D medical images into 3D spatial models, improving surgical planning, teaching and collaboration. Studies show that the use of virtual reality reduces surgical risk. The technology provides the next generation of surgeons with realistic surgical simulations. These three-dimensional spatial models can be viewed using virtual and mixed reality devices, so that each patient's anatomy can be carefully studied before the procedure begins [6].

The Wayback team, on the other hand, has focused on the patients with Alzheimer's disease and dementia. VR therapy allows them to regain the skill of meaningful communication, improves their emotional well-being and, in some cases, slows the progression of the disease. "By recreating positive moments from the past, we bring viewers back in time, evoking memories and sparking precious conversations" [7]. Wayback's films are unlike any other virtual reality film. Each is the result of countless hours of research and "memory sessions" in nursing homes. This framework ensures that each scene is filled with thousands of details that evoke different memories and emotions for anyone old enough to be there. It is the small common details that evoke the strongest memories.

The Luminopia One VR headset is designed to improve visual acuity in children aged 4-7 years with amblyopia. Amblyopia ("lazy eye") is a visual impairment in which one eye is not involved in the visual process. About 3 % of

all children in the world suffer from this disease. Luminopia One provides entertainment content to attract the attention of children and ensure more effective treatment. Thus, watching movies becomes one of the ways to treat diseases [8].

Besides the movie, video games can also affect our vision with virtual reality technology (Figure 1). Diplopia hopes to restore three-dimensional vision in adults with the help of games. Thanks to a special mode, a person can customize the look inside the game for each eye.

“2019: The Year Virtual Reality Gets Real”, Forbes magazine outlines [10]. That’s when the Oculus Quest headset appears on the market, which allows one to fully experience virtual reality without connecting to a PC (Figure 2). The device has a built-in proximity sensor. Internal tracking works using 4 cameras on the helmet body. The virtual reality glasses themselves are safe for human eyes if the operating rules are followed.

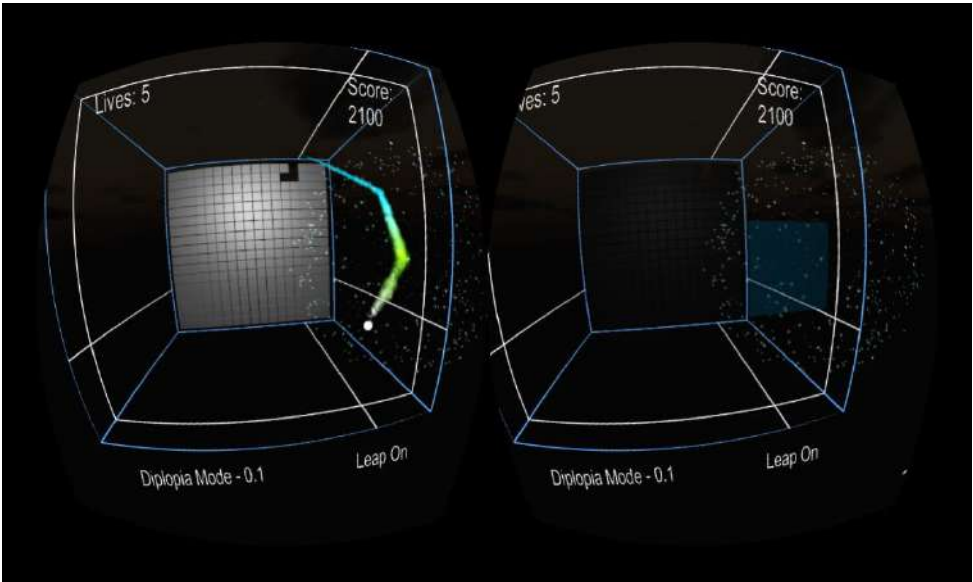


Figure 1. Diplopia game



Figure 2. Oculus Quest 2019

Medicine has great prospects in the application of virtual reality. However, more development in this area requires not only the support of the state, but also the mastery of technology, new surveys, and projects. According to experts, AR and VR will be one of the key technologies, on the threshold of which our civilization is now. Many companies use modern technologies to improve medicine and treat as many diseases as possible, and this is good news. We have not named all the companies, but only those that have shown the effectiveness of their treatment. There are a huge number of them and they still have to develop in many ways, cultivating opportunities for people who were deprived of them for some reason. Thus, the future is in our hands.

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INTRODUCTION OF MACHINE TEXT TRANSLATION AS A SOLUTION THE LANGUAGE BARRIER IN BUSINESS AREA

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Abstract. The article analyzed the advantages and disadvantages of machine translation. The research aims to explore the main problems using modern machine translation systems. In this case, authors considered the quality of computer translation, evaluated the correctness and identified typical errors and distortions of machine translation. This study offers the following recommendations for optimizing computer translation.

Keywords: language barrier, machine translation, online translator, machine learning, optimization.

ВНЕДРЕНИЕ МАШИННОГО ПЕРЕВОДА ТЕКСТА ДЛЯ РЕШЕНИЯ ПРОБЛЕМЫ ЯЗЫКОВОГО БАРЬЕРА В БИЗНЕСЕ

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Аннотация. В статье рассматриваются достоинства и недостатки машинного перевода. Целью данного исследования является анализ основных проблем, связанных с переводом при помощи современных систем машинного перевода. Рассматривалось качество компьютерного перевода, была оценена корректность машинного перевода, и определены типичные ошибки и искажения машинного перевода. С учетом проведенного анализа ошибок даны рекомендации по оптимизации компьютерного перевода.

Ключевые слова: языковой барьер, машинный перевод, онлайн-переводчик, машинное обучение, оптимизация.

All processes of globalization and digitalization in all spheres of people's activity have positive and negative consequences. International trade opportunities increase every day, people's communication rises, and many people are native speakers of different languages.

According to statistics, there are about seven thousand languages in the world, and the share of English in the Internet space has fallen to 25 percent in recent years. Respectively, there is a problem of the language barrier and the solution of this issue can facilitate both simple communication of people speaking different languages, and more formal communication, for example, international negotiations or doing business. For the latter, solving the problem of the language barrier can bring huge profits and establish new supply chains. Companies that have localized their content are 2.5 times more likely to experience year-on-year profit growth and 1.8 times more likely to experience revenue growth. When implementing machine translation, in addition, you can save money on translators, and the better the program, the less time it will take for a person to check the translated text. One example is a solution from LingvaNex. They provide machine translation of texts for business without data security threats. This program has several thousand positive reviews from a wide range of specialists [1].

Of the most widely used analogues of the proposed solution in large enterprises and corporations, of course, are the specialized department of employees. The creation of a division specializing in professional translation makes it easy to hold events with the invitation of foreign partners, as well as correctly compile and translate corporate documents for the implementation of transactions and contracts. The obvious drawback is the additional costs on the part of the business for the creation of this department, for constant tax payments, the problem in changing the perspective of the enterprise to other markets, with an excellent language up to the current moment, and the need to hire more employees.

More generally accepted analogues, which are used everywhere by smaller enterprises, are numerous online translators. The most famous Russian online translator is Yandex.Translation [2]. This service offers the user a huge functionality for personal use: automatic language detection, text voicing and word spelling checking. However, like any other automatic translation, this service is not able to get rid of literal translation errors. Documents created with the help of an online translator turn out to be meaningless, devoid of semantic logic, sometimes with the assumption of gross errors due to the problem of ambiguous translation. Unlike machine learning methods, which can “learn” from their own mistakes and improve their abilities in further work [3].

Optimization from the implementation of this solution is primarily in:

1. Reducing the number of employees required for translation, compilation and support of documentation in foreign languages.
2. There is no need to change the staff of the linguistic department in the event of a market change.
3. Reduction of outsourcing costs for the translation of contracts [4].

Summarizing the conducted research, we can put forward that the research has achieved its goal. With the accelerated growth of information technology and the possibility of introducing automated translation methods, the chances of a business entering an international or global market have increased dramatically. The issue of monetization and the possible effect of using the proposed technologies requires further research.

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CYBERCRIME AND INFORMATION SECURITY IN THE RUSSIAN ECONOMY

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Abstract. An active development of information technology has affected all sectors of the economy. This article is devoted to the study of new technologies that change the perception of business and bring impressive benefits for both financial sector organizations and their clients. The implementation of advanced digital technologies for information security is considered in the article.

Keywords: cyberthreats, information, cyberspace, information security, cybercrime.

КИБЕРПРЕСТУПЛЕНИЯ И ИНФОРМАЦИОННАЯ БЕЗОПАСНОСТЬ В РОССИЙСКОЙ ЭКОНОМИКЕ

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Аннотация. Активное развитие информационных технологий повлияло на все отрасли экономики. Данная статья посвящена изучению новых технологий, которые меняют представление о бизнесе и создают значительные преимущества как для организаций финансового сектора, так и для их клиентов. Рассматривается внедрение современных цифровых технологий для обеспечения безопасности информации.

Ключевые слова: киберугрозы, информация, киберпространство, информационная безопасность, киберпреступность.

Cybersecurity or information security is a combination of various modern technologies and processes that are designed to protect networks, devices and data from attacks or unauthorized access [1]. This activity is one of the most relevant in the present and is developing by leaps and bounds. The main task of companies involved in cybersecurity is to protect confidential information from access by intruders, its modification and blackmail for unscrupulous earnings.

The development of digital technology in the country does not stand still, as it is at the state level of importance, as confirmed by the Presidential Decree of 09.05.2017 № 203 “On the strategy for the development of information society in the Russian Federation for 2017-2030”.

Not only private firms, but also government agencies are regularly interested in and analyzing the information security market. Vulnerability analysis and remediation services provided by cybersecurity professionals are in high demand.

One of the domestic leaders in the field of information security is the company Positive Technologies. Its main areas of activities: studying modern security threats and creating products and services to combat hacking of information systems. About 40 government institutions, more than 50 banks and financial institutions, 20 telecommunication companies, more than 40 industrial enterprises, IT-industry companies, service and retail companies use its technologies [2].

In Russia, there are problems of providing a secure information space not only for financial institutions, but also for various sectors of government activities, which suffer economic damage from the unlawful actions of perpetrators. Figure 1 shows a diagram on the distribution of the main consumers.

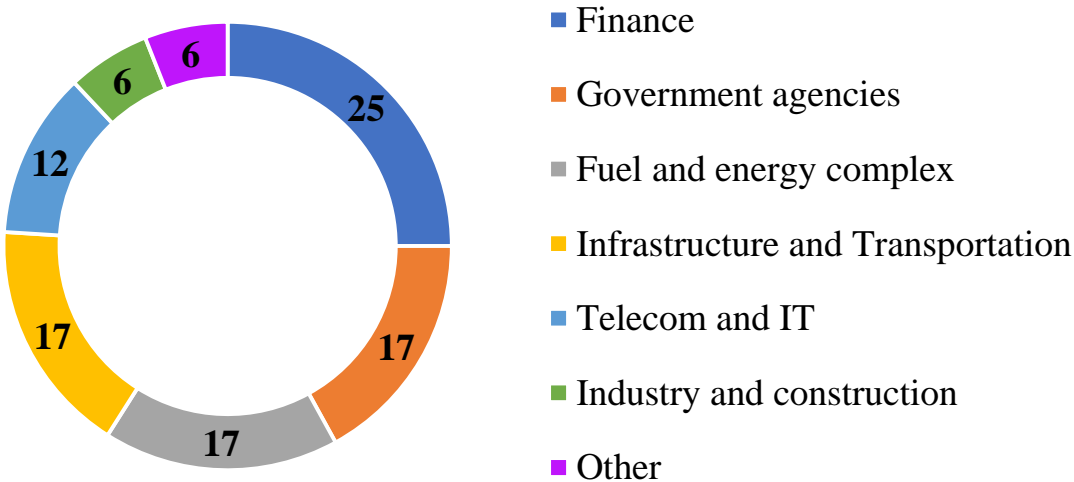


Figure 1. Sectoral segmentation

The diagram shows that the main corporate customers are financial and banking structures, as well as government, industrial and transport customers.

The financial and banking sector, which is actively mastering the latest digital and information technologies, is one of the most attractive targets for cybercriminals. The banking sector accounts for 70 % of hacker attacks, and the rest of the attacks mostly target companies in the fuel and energy complex and industrial enterprises. According to IMF estimates, financial institutions' losses from cyberattacks can average several hundred billion dollars a year, reducing banks' profits and potentially threatening financial stability. For example, annual losses to the global economy from cyberattacks amount to \$1 trillion, while the Russian Federation's losses reach more than 600 billion rubles. So far, a record number of unauthorized access to information occurred in 2021. For the most part, this is due to the mass transfer of employees to remote work due to the COVID-19 pandemic, as many services and services have become located in the information space.

Attackers are still actively using strategies mastered during the pandemic. Current financial problems have exacerbated the use of malicious activity against banks and their customers.

However, the trend of cybercrime is now changing its targets. The amount of malware for PCs and mobile devices is dropping rapidly as attackers target entire corporations. The result of their activity is malicious products designed not only to attack financial sector branches, but also online banking, payment systems, online stores, e-money and cryptocurrency services.

Among the hacker groups attacking banks around the world, the majority are Russian-speaking. The “Russian-speaking troika” stands out among them: Cobalt, Silence and MoneyTaker, which initially operated in the Russian market and is now expanding geographically abroad, particularly in India, Vietnam, Pakistan, Chile, Malta and other countries. In addition to the “Russian-speaking troika”, the North Korean group Lazarus and a new group from Kenya, SilentCards, have been particularly active in attacking banks around the world [3]. Targeted attacks on banks by these five hacker groups pose a real threat to the global financial sector.

Therefore, for more than 20 years Positive Technologies has been researching information security and developing products and services that help detect, verify and prevent unacceptable events in the information infrastructure of individual enterprises, industries and entire countries [2]. Positive Technologies is also the first and only public domestic cybersecurity company on the Moscow Stock Exchange (MOEX: POSI).

In addition to large banks, there are many financial institutions that lack sufficient financial and human resources. The regulator, the Bank of Russia,

intervenes in such cases. Thus, recently new structural divisions have been introduced, such as the Department of Financial Technologies and the Center for Monitoring and Responding to Computer Attacks in the Credit and Financial Sector [4]. The introduction of an automated incident information processing system makes it possible to respond quickly to frequent small-scale cybercrimes. In early 2020, the Bank of Russia introduced penalties for not having systems in place to track suspicious activity for its customers, we are talking about atypical transactions that can be committed by fraudsters.

The regulator is actively developing and introducing general requirements for the information infrastructure of banks and other financial institutions, their data storage system and information security of the digital space. The introduction of such standards should stabilize the activities of institutions, as well as strengthen cybersecurity.

A couple of years ago, cybersecurity was considered a formal task and no actionable solutions were taken. However, in 2021, businesses realized that information security must be actionable and can be measured. The effectiveness of the work done can be evaluated by actually simulating the actions of intruders. In addition to the above vulnerabilities in the information space, cybercriminals successfully practice social engineering, as well as take advantage of the problem of employee negligence. However, the basic remedy for improving protection is the development of cybersecurity as a whole.

Information security is related to changes in the business, which means it requires an investment. It requires the ability to have management skills and knowledge. Therefore, IT professionals are being replaced by professional managers who know how to run a business competently. This shift requires a simplification to understand the field of cybersecurity. This poses a new challenge: making information security understandable for any manager or company owner.

Cybersecurity is extremely important in today's world. Since its inception, the computer network has been attacked by cybercriminals, and it is clear that the threat of cyber-attacks will increase as the network grows. However, with the right equipment and expertise, it is quite possible to control the damage and compensate for the losses caused by cyberattacks. To reduce the risks of cyber-attacks, the government is taking various measures to make the fight against cybercrime truly effective, namely, encouraging the development of domestic cybersecurity solutions to ensure the information and technological independence of the Russian Federation.

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ARTIFICIAL INTELLIGENCE AND ART. THE POSSIBILITY OF REPLACING PEOPLE WITH AI IN THIS AREA

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Abstract. This article deals with the functioning of Artificial Intelligence in creating pieces of artwork. Considerable attention is paid to the ability of Artificial Intelligence to replace humans in creative jobs.

Keywords: artificial Intelligence, algorithms, art, neural network, copyright.

ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В ИСКУССТВЕ ВОЗМОЖНОСТЬ ЗАМЕНЫ ЧЕЛОВЕКА В ЭТОЙ ОБЛАСТИ

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Аннотация. В данной статье проводится анализ работы искусственного интеллекта по созданию произведений в различных сферах искусства. Особое внимание уделяется способности искусственного интеллекта заменить человека в области искусства.

Ключевые слова: искусственный интеллект, алгоритмы, искусство, нейронная сеть, авторское право.

Artificial intelligence is the ability of a machine or a program to perform the tasks that people are still performing themselves. Its main task is to expand human capabilities and bring benefits. AI strives to imitate human thinking and behaviour, and is able to learn independently. We often imagine AI being humanoid robots that are about to take over the world. But in fact, artificial intelligence is not scary and smart.

For the first time, the term “Artificial Intelligence” was coined in 1956, but it gained its real popularity not so long ago, because performing complex tasks requires powerful computing technology and fast processing speed of large amounts of data. This became possible only in the 21st century [1].

And what about art? Artificial intelligence enters the artistic sphere no worse than other professional fields, it affects creative processes, and even such a phenomenon as “digital art” has emerged.

And he has already begun to play a very important role in various aspects of art. Without digital processing and computer effects, it's impossible to imagine either modern cinema or music. Nowadays, the computer has become a palette and a musical instrument [2].

In the case of the creative works, artificial intelligence is called a neural network (a machine learning algorithm). This is a special case of AI. A neural network is a set of simple, interconnected elements that add up to a primitive likeness of the brain. It analyses the works uploaded to its database, recognizes images, sounds, techniques, signs of style, and then uses the knowledge gained to create works. The neural network will mark all the smallest details and features of the work and correlate them with each other. But, nevertheless, AI is completely unable to isolate meanings and create a coherent narrative.

At the same time, the development of digital art brings up the question: Can AI become not just a tool, but an independent author?

We have carried out a survey on the “VKontakte” social network. 27 people from different countries participated in the survey: 21 respondents from Russia, 4 from Ukraine, 1 from Belarus and 1 from Estonia. The age of respondents is from 16 to 25 years. It was possible to choose several options, provided that the “Nowhere” option was not selected.

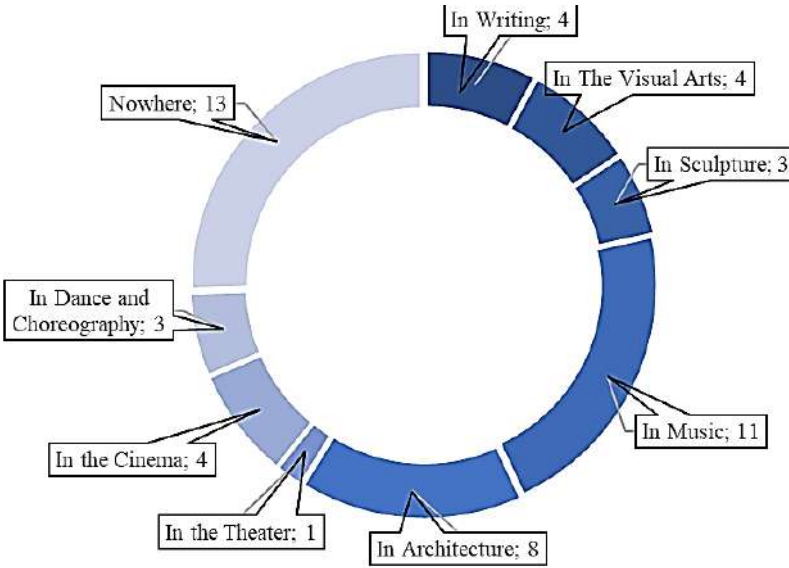


Figure 1. Survey Result

Nowadays, algorithms write soundtracks for games and adjust the music in headphones to our mood. The first composition composed by artificial intelligence was released back in 1956. Two professors at the University of Illinois, Lejaren and Leonard, wrote down the rules on the basis of which the machine generated a code, which was then transferred to the notes. The result of the experiment was a four-part composition for strings, which was called the Illiac Suite [3].

How does it work? After analyzing a lot of existing compositions, the system makes its own music. The software receives a lot of material, from disco

classics to dance pop hits, in which the software is looking for some patterns. These programs are sensitive to chords, tempo, duration of notes and their relation to each other. But experts remark that just by training a neural network on thousands of songs, you cannot force a computer to write music, because it is too complex and multidimensional.

The use of artificial intelligence helps painters to become famous. Or those who only dreamed of it become painters. AI paintings are already being sold at auctions, so in 2018, “Portrait of Edmond De Bellamy” was sold for \$ 432,500. The work was an unfinished portrait of a man who looked like he lived in the XVIII-XIX century. And six months before that, another painting from this series was sold: “The Countess Bellamy”.

A historic event in the sale of the painting was that the painting was put up for auction by the Christie's auction house – one of the two main global art market sites. In the art world, this automatically means recognition - both for the artist and for a new direction in art [4].



Figure 2. Portrait of Edmond De Bellamy



Figure 3. Portrait of The Countess of Bellamy

The neural network that created the painting “Portrait of Edmond De Bellamy” was trained on 15,000 portrait works painted in the period from the XIV to the XX century.

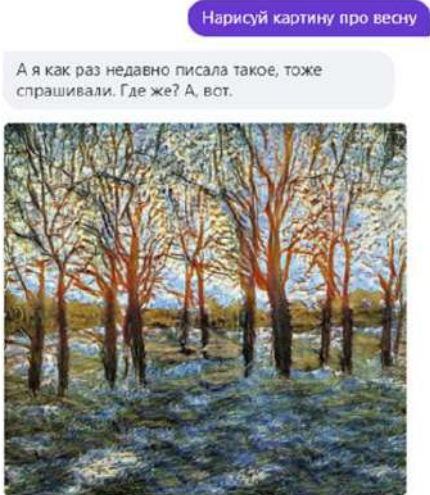


Figure 4. Alice's Painting

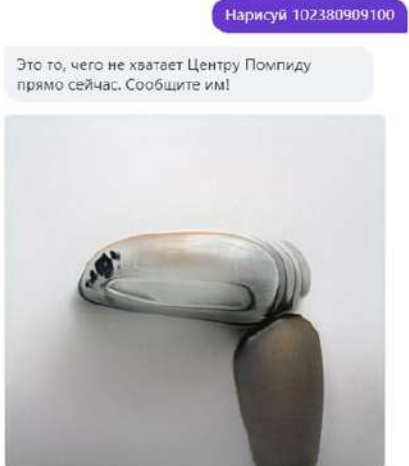


Figure 5. Alice's Painting

Absolutely anyone can become a customer of a painting from AI, totally free of charge. It is enough to open Yandex.Browser and say into the mic: “Alice, draw a picture”, and at the same moment you will get a completely new picture especially for you. You can ask for a picture on a certain topic, for example, a picture about spring. Alice will even draw a set of numbers that you will voice. They say that in 2049 the machine will write a novel that will become a New York Times bestseller. Already today, the work of AI has touched the Harry Potter fandom: the neural network has written a chapter of the new book “Harry Potter and the Portrait of what Looked Like a Large Pile of Ash.” The algorithm was trained on the previous seven books, and, according to fans, the fan fiction came out quite high-quality [5].

Artificial intelligence “Scheherazade – IF”, after reading about two hundred stories about a cinema date and a bank heist, created exactly such stories based on them. Interestingly, even when Scheherazade was asked to write simple tales, it came to absolutely unexpected results. After requesting a story about a cinema date, the system quickly realized that people should hold hands and kiss, and not just buy tickets and look for seats in the hall.

Scheherazade doesn't understand what's going on in the tales it reads, but it recognizes repetitive patterns. When the system sees a set of offers from different people that relate to the same event, that it understands that something serious is happening. It can also learn that some events happen after others, as a result making up a kind of map for the development of the story [6].

The recognition of AI as full-fledged authors tells us that their texts are now becoming the object of copyright. In 2020, in China, for the first time in history, a court copyrighted a text written by AI. The Court found that the wording of the article had “a certain originality” and complied with the legal requirements of the written work [6].

Sculptures created by artificial intelligence are not as popular as paintings yet, but there is still progressing in this direction, for example, the Dio sculpture, the material for which was the remains of the computer on which it was designed [7].



Figure 6. Dio

The implementation of AI in architecture is still at the initial stage, but shows promising results. The potential of AI can greatly push the architecture forward. At the same time, it is only an architect's tool. However, using an intelligent assistant allows architects to free themselves from routine work, allowing them to focus on the creative process.

The development of computer technology has allowed such a design system as parametric (algorithmic) architecture to claim the role of the leading style of the new era. One of the ideologists of parametricism is Patrick Schumacher, the architect of the world-famous Zaha Hadid Architects.

Artificial intelligence can get its role not only at the design stage, but also in planning and building. AI can analyze a huge amount of data about materials, interpret the environment of a building, create cost estimates and transmit the result of calculations to the architect, reducing the preparation time for construction. In addition, in the future, some parts of buildings can be erected without human intervention. Definitely, artificial intelligence opens up new horizons and creative challenges in architecture [8].



Figure 7.
Parametric Building in Spain



Figure 8.
Parametric Building in Spain

In order for movies to be created faster and bring more profit, artificial intelligence technologies are being introduced into the movie industry. With their help, they create graphic and trailers, predict the success of upcoming projects, select the cast and write scripts.

Artificial intelligence not only assists in creating a movie, but also creates one on its own. In 2018, the AI “Benjamin” created a black-and-white short movie *Zone Out* in two days. The system took over the entire process of movie production: it generated the plot, wrote the dialogues of the characters, determined the emotions of the actors, and also mounted the picture, voiced the characters and selected the music. “Benjamin” independently selected fragments from old movies for his own project. The actors' faces were superimposed on the desired scenes and demonstrated the emotions chosen by the AI [9].

With cinema, everything is more or less clear, but what about the theater? The differences from filmmaking are minor, AI is already writing plays. AI

tends to create melodramatic stories about sex, violence and death. He also demonstrates prejudices by insisting on describing the terrorist character, portraying him as a Muslim in flowing clothes, and sometimes spewing voluminous information, as if from a Wiki page [10].

Dancing has been present in every culture throughout the history of humanity and is one of the oldest forms of our self-expression. Facebook AI has decided to train the AI to move in rhythm as well.

This is not the first try to train artificial intelligence to dance. In 2016, Swedish choreographers used 48 hours of recordings of dance movements by one of the choreographers to train the neural network Chor-rnn. Their system could not only reproduce new dances, but also do it in a specific style. However, this system just imitated the dance moves shown, the data received is based on observing how people dance, and not on their own representation of new dances. Moreover, they were limited to the dance styles and music they trained on. It was impossible to expect that a model trained in classical music would be able to create movements in the style of funk or disco [11].

AI also helps those people who can't dance at all. Scientists at the University of California at Berkeley have created a neural network that simulates dance movements from one video clip to another and anyone, thanks to it, can turn into a professional dancer [12].

“Will AI replace humans in art?” Obviously not. Artificial intelligence, unlike humans, has no consciousness (explanation: intelligence is the ability to learn and apply knowledge in practice; consciousness is a subjective perception of the world and its states). Don't be afraid that AI will replace a human in the creative field. AI in art is a human tool, an artist's brush and a writer's pen, and not the artist and writer himself as a full-fledged creative person.

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OPERATION DESCRIPTION OF AIR MASS METER FOR ENVIRONMENTAL MONITORING SYSTEM

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Abstract. This paper discusses the construction of an airspeed meter for atmospheric monitoring systems using a unipolar ion label. The operation of the sensor is described, as well as the timing diagrams of the results.

Keywords: airflow meter, ion label, unipolar ion label, atmospheric monitoring systems.

ОПИСАНИЕ РАБОТЫ ИЗМЕРИТЕЛЯ МАССЫ ВОЗДУХА ДЛЯ СИСТЕМЫ МОНИТОРИНГА ОКРУЖАЮЩЕЙ СРЕДЫ

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Аннотация. В данной статье описывается конструкция измерителя воздушной скорости для систем мониторинга атмосферы с использованием униполярной ионной метки. Представлена работа датчика, а также временные диаграммы результатов.

Ключевые слова: расходомер воздуха, ионная метка, униполярная ионная метка, системы мониторинга атмосферы.

Introduction

An environmentally friendly atmosphere is the most important factor in vital life activity of a person. That is why today a great importance is paid to effective atmospheric monitoring systems. Modern atmosphere monitoring systems allow people to organize a comfortable and healthy way of life.

Successful long-term operation of such systems is impossible without their accurate and high-quality setting-up of equipment and constant technical maintenance. Regular measurements of various operating parameters, including air flow measurement, also serve to determine the efficiency of the equipment.

In this work, such tasks as the development and description of the structural and functional scheme, the algorithm of the device and the time diagrams of the ion-label air flow meter are solved.

Structural and functional diagram of an ion-label air flow meter

Figure 1 shows a structural and functional diagram of an ion-label air flowmeter (ILAF) with the usage of an ion-label generator and recording electrodes [1]. The air flowmeter for the atmosphere monitoring system measures the air flow velocity, on the basis of which the volumetric air flow is calculated, which makes it possible to optimize and achieve more efficient performance of the atmosphere monitoring system, which in turn organizes comfortable human life, informing users about the state of the atmosphere or air in the room where this system is located.

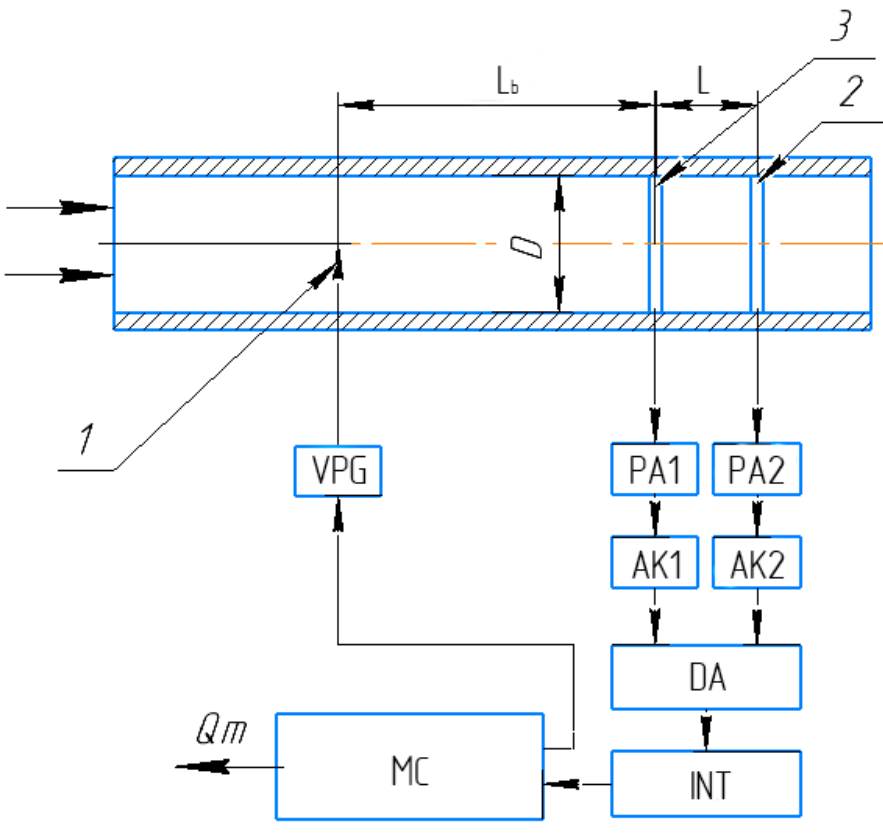


Figure 1. Structural and functional scheme of ILAF

The electrodes of the recorder are made in the form of insulated rings with a diameter equal to the diameter of the flow channel and are located from each other at a distance equal to one and a half of the radii of the flow channel.

Thus, the functional diagram of the ion-label airspeed meter (Figure 1) contains a flow channel in the form of a tube with a diameter D , in the input part of which there is a spark gap 1 connected to a high-voltage pulse generator (VPG). Along the course of the air flow in the flow channel, two isolated annular electrodes 2 and 3 of the ion label recorder are located at a distance ΔL

relative to each other. In this case, the diameter of the electrodes is equal to the diameter of the flow channel, and the placement distance from the spark gap to the first electrode 2 is $L_b - \Delta L$, where $\Delta L = 1.5R$ (R is the radius of the flow channel) [2]. The electrodes 2 and 3 through the pre-amplifiers PA1 and PA2 and the analog keys AK1 and AK2 are connected to the differential amplifier DA, whose output is through the integrator INT. The output of the comparator is connected to the input of the microcontroller (MC), the control output of which is connected to the VP generator. With MK, we receive a ready-made information signal Q_m on gas consumption.

*Description of the structural and functional scheme
of the ion-label gas flow sensor*

The airspeed meter works as follows. In accordance with a given program, the MC generates pulses at a certain frequency at the control output, which trigger the PG label generator. A short high-voltage pulse enters the spark or corona spark gap and causes a spark or corona breakdown, respectively. As a result of the breakdown in the vicinity of the spark gap, the air is ionized, and ions with an electric charge are formed, thus an ion label is formed, which moves along with the air flow [3].

It leads to when a charged ion label passes near the electrode 2, a current pulse is induced on the latter, which is amplified by the pre-amplifier PA1. The pulse U_1 at the output of PA1 has the form shown in Figure 2 b. A similar pulse U_2 is formed at the output of PA2, but since the electrode 3 is separated from the electrode 2 at a distance of ΔL , the pulse U_2 has a corresponding time delay relative to the pulse U_1 . Analog keys AK1 and AK2 allow at time t_0-t_1 (duration approximately 200ms) to open the circuit to eliminate interference with the PA at the input of the remote control (Figure 2 a). Next, both pulses are fed to a differential amplifier, at the output of which a signal of difference $U_1 - U_2 = U_2$ is formed (Figure 2 c). This signal is led to the INT integrator, the output signal of which U_{integr} (Figure 2 d) is supplied to the MC with a built-in comparator. The comparator fixes the temporary position of the intersection point with a zero-level U_{integr} signal. Next, a time interval is formed, the beginning of which corresponds to the moment of generation of the ion label, and the end to the moment of crossing the boundary of the base distance L_b , which is located between the electrodes 2 and 3 at an equal distance from them $0.5 \Delta L$. According to the duration of the time interval τ in MK, the air flow velocity $V = L_b / \tau$ is calculated. The measurement result is stored in the memory of the microcontroller.

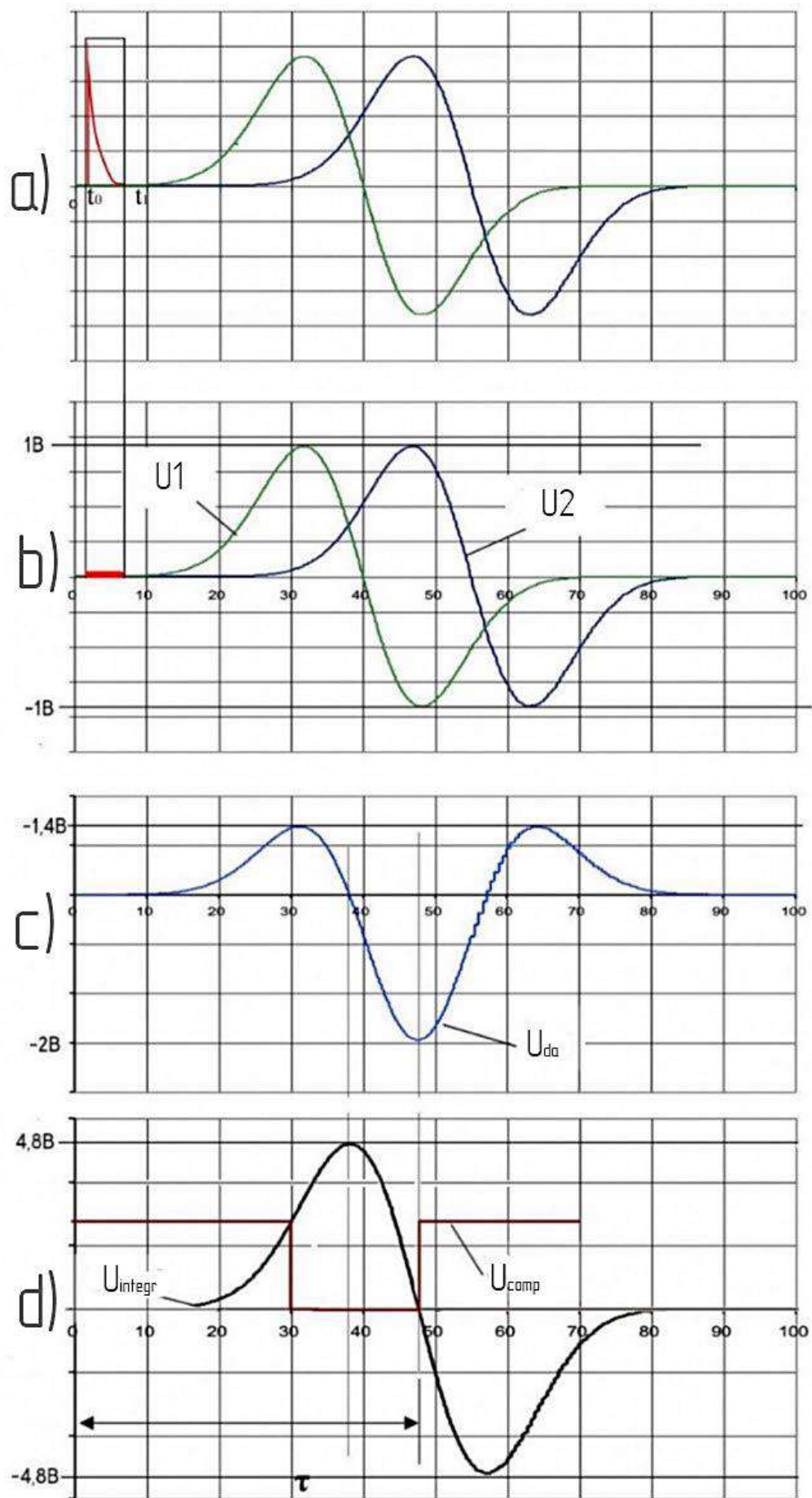


Figure 2. Time diagrams

Thus, in this work, a structural and functional scheme was developed and the algorithm of the device operation and time diagrams of the ion-label air flow meter operation are presented.

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PRINCIPLE OF OPERATION AND APPLICATION OF A CONTINUOUS RECTIFICATION COLUMN

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Abstract. This article is devoted to the study of the operating principle of a distillation column, its structure and application. The processes of mass and heat transfer and the method for calculating the optimal reflux ratio are also considered.

Keywords: rectification column, reflux, separation of mixtures, heat exchange, mass exchange, distillation.

ПРИНЦИП РАБОТЫ И ПРИМЕНЕНИЕ РЕКТИФИКАЦИОННОЙ КОЛОННЫ НЕПРЕРЫВНОГО ДЕЙСТВИЯ

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Аннотация. Данная статья посвящена изучению принципа работы ректификационной колонны, ее строения и применения. Также рассмотрены процессы массо- и теплообмена и способ расчета оптимального флегмового числа.

Ключевые слова: ректификационная колонна, флегма, разделение смесей, теплообмен, массообмен, перегонка.

Concept of rectification. Rectification was invented at the beginning of the 19th century as one of the most important technological processes of an alcohol and petroleum industry. Nowadays, rectification is used in a different spheres of the chemical industry, where a chemically pure component needs to be isolated, for example, during the course of organic synthesis, in the production of isotopes of various chemical elements, polymers and semiconductors etc. [1].

Rectification is a stepwise or continuous interaction of non-equilibrium liquid and vapor. During rectification there is a thermal and mass exchange

between the liquid and condensed droplets due to the countercurrent between the liquid and gaseous phases of the mixture.

Rectification is carried out:

- 1) at atmospheric pressure;
- 2) under vacuum (used if the components have a high boiling point).

Vacuum reduces the boiling point;

- 3) under increased pressure (used to separate gas mixtures that are in the liquid state).

Continuous rectification is used to separate liquid mixtures in multi-tonnage production. Its feature is that the flow rate and compound of the initial mixture remains constant [2].

The peculiarity of continuous rectification causes a number of cons and pros. On the one hand, continuous rectification requires more regulating and controlling devices than periodic rectification. On the other hand, this type of rectification helps to reduce costs because of using normalized columns and heat exchangers, allows to conduct processes in stationary conditions, helps to keep constant costs of heating steam and circulating water, allows to provide more effective process control and doesn't require careful quality control of the resulting products [3].

Principle of operation and design of a continuous rectification column.
Let's consider the principle of operation and design of a column (Figure 1).

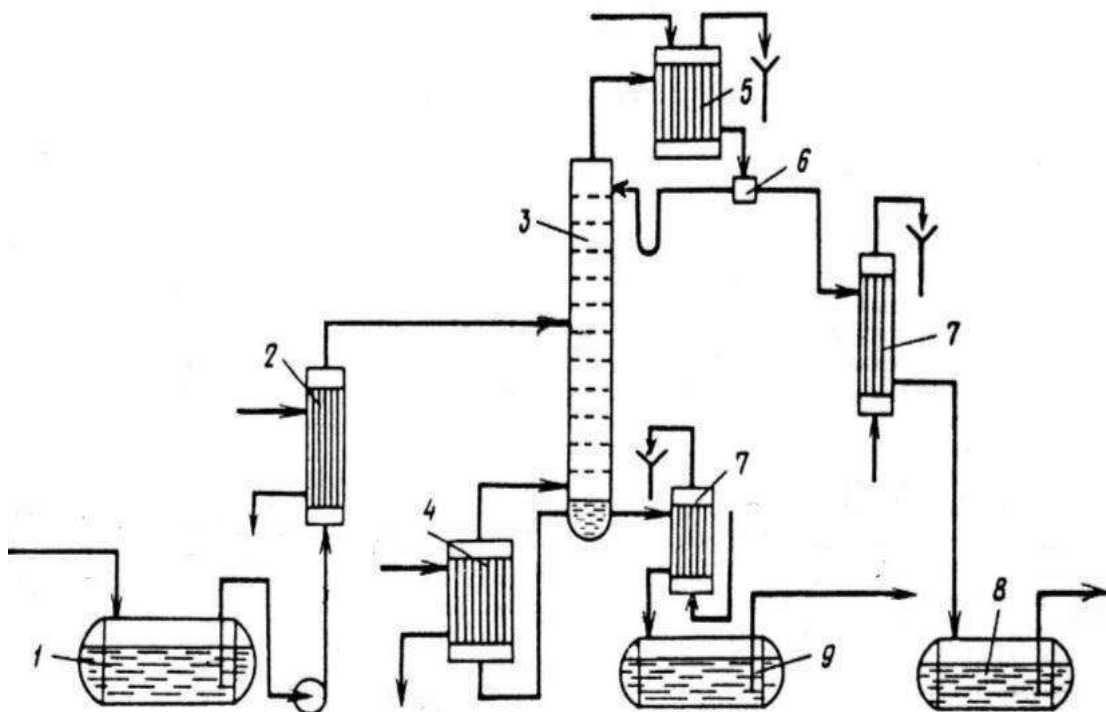


Figure 1. Design of a continuous rectification column

Initial mixture enters the container for the initial mixture (1). After it, this mixture with help of the pump enters the heat exchanger (2), which works by exchanging of thermal energy between the initial mixture and hot steam. Steam enters the heat exchanger through its upper left part and condensate drains through its lower left part. Steam isn't in contact with the mixture. It's going through the pipes, which is located inside of the heat exchanger. Inside of the heat exchanger initial mixture becomes steam mixture. Later, this steam mixture enters the column (3), which includes some number of plates. The liquid, which flows down the plates, is enriched with the high-boiling component, and the concentration of the low-boiling component increases in the steam, which rises upwards. The steam leaves the column in its upper part. After that, it enters the dephlegmator (5), where it condenses and enters the reflux drum (6). The condensate is separated into two streams: reflux and distillate. The reflux is pumped back to the column. The distillate is cooled in the cooler (7). Cold water enters the bottom of the cooler, which is not in contact with the distillate, but flows through the pipes inside the cooler. The counterflow between the distillate and the cold water provides the heat exchange. After the heat exchange, the water goes to the common sewer for production needs. Finally, the distillate goes into the distillate collecting tank (8). For example, at separation of ethyl alcohol-water mixture in distillate collecting tank there will be pure ethyl alcohol. The liquid, which flows down to the bottom of the column, is also separated into two streams: the vat residue and the vat liquid. The vat residue is cooled down in the cooler (7) and goes into the vat residue tank (9). The vat liquid enters the heat exchanger (4). Then in the form of steam it enters the lower part of the column, providing an effective mass transfer on the plates [4].

Calculation of the optimal reflux number. Before building or buying a distillation column, the reflux number must be calculated. This parameter will affect the quality of the product, the speed of the process and the size of the column.

The reflux number is the ratio of the amount of liquid flowing from any plate in the concentration (upper) part of the column to the amount of distillate to be withdrawn.

One of the methods is graphical. It is based on plotting and finding R_{opt} and R_{min} , that is optimal and minimum reflux numbers, through the value of the line segment S . This is a line segment of the ordinate, which connects the beginning of coordinates with the intersection of the ordinate and the line describing the values of concentrations of components (Figure 2).

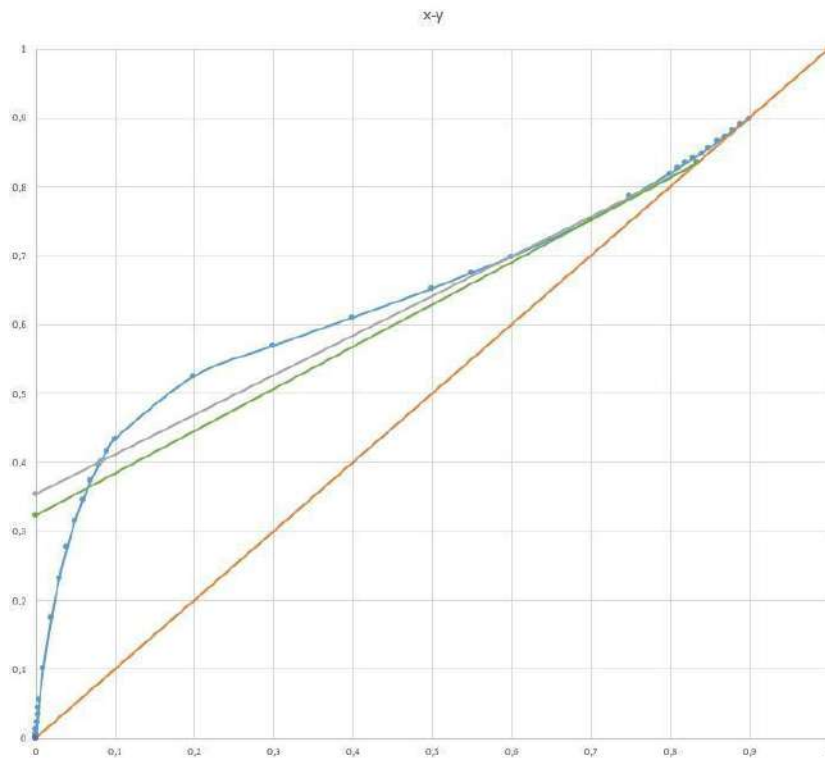


Figure 2. Determination of the minimum reflux number from the X – Y diagram

As the diagram must necessarily be square, the orange line is the diagonal, at the top of which all the points converge. The blue line is the equilibrium line. It is determined and drawn by reference data and takes into account the thermodynamic equilibrium of the system's components.

This diagram (Figure 3) shows the case for the ethyl alcohol-water system separation. Here, the gray line is the line that describes the values of the concentrations of the components in the mixture. In this case, it is not tangential to the equilibrium line, so an additional line (green) is drawn from the same point where the gray line begins. This is done to make sure that the R value will not be overestimated due to high concentrations of the components.

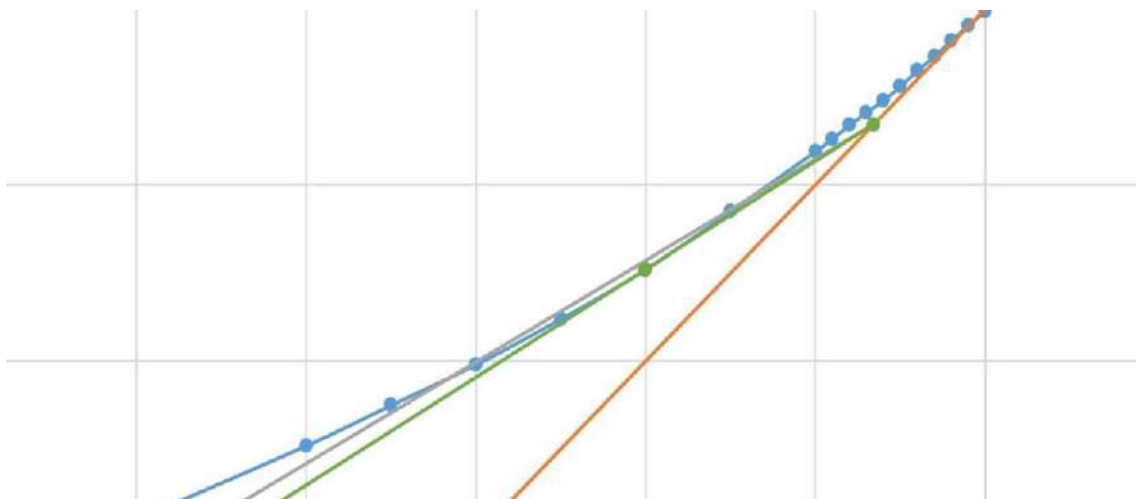


Figure. 3 Enlarged fragment of the X – Y diagram

From this diagram we can calculate the value of S , which for this mixture will be 0.323. Then from the formula:

$$S = X_p / (R_{min} + 1)$$

we express the value for the minimum number of plates. Thus:

$$R_{min} = (X_p - S) / S, \text{ where}$$

X_p is the molar concentration of the volatile component in the distillate. In this case it is 0.8343 g/mol. Substituting all values into the formula, we get the reflux number equal to 1.583. This is the minimum reflux number needed for rectification of the ethyl alcohol-water mixture.

Unfortunately, the calculations do not end here. It is necessary to know the optimum value of reflux number to ensure the most effective heat and mass exchange on the plates. There is another formula for this:

$$R_{opt} = 1.3 * R_{min} + 0.3, \text{ where}$$

1.3 and 0.3 are coefficients.

Thus, we get the value of optimum reflux number equal to 2.3579. This parameter is obligatory for calculation at work with a rectification column [5].

Application of a continuous rectification column. Continuous rectification is used everywhere. The basic concepts of rectification are used by ordinary people who prepare alcohol at home. Laboratories of universities and research institutes use units that resemble smaller versions of industrial rectification apparatuses.

Today it is impossible to imagine an industrial distillation or extraction process without a rectification column. Refining, petrochemical, chemical, gas, brewing industries cannot exist without apparatuses of this type. Taking into account all possible advantages of continuous columns, we can confidently speak about their importance and indispensability in modern industries.

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SUBSOIL: LEGAL REGULATION

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Abstract. This paper considers some aspects of the use and protection of the subsoil, its legal regulation, as well as the problems existing at the legislative level concerning obtaining a license for the subsoil usage.

Keywords: subsoil, legal regime of subsoil, subsoil usage, license.

НЕДРА: ПРАВОВОЕ РЕГУЛИРОВАНИЕ

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Аннотация. В работе рассматриваются некоторые аспекты использования и охраны недр, их правовое регулирование, а также существующие на законодательном уровне проблемы, касающиеся получения лицензии на пользование недрами.

Ключевые слова: недра, правовой режим использования и охраны недр, пользование недрами, лицензия.

Since the sole owner of the subsoil in the Russian Federation is the state, the issues related to the use of the subsoil are currently relevant due to the peculiarities of the mechanism for providing the subsoil for use by specialized organizations. For example, for the extraction of minerals specifically for the construction and maintenance of public highways, the right to use a local subsoil plot is granted without an auction, unlike the other numerous cases listed in the Subsoil Law. However, this procedure does not imply simplification of obtaining a license for the subsoil usage. In addition, this procedure entails the opening of industrial quarries.

According to the preamble of the Subsoil Law, the subsoil is a part of the earth's crust located below the soil layer, and in its absence – below the earth's surface and the bottom of reservoirs and watercourses, extending to depths accessible for geological study and development.

Latypova E., considering this norm, draws attention to the fact that the legislator officially designated the national significance of natural resources, the same applies to the subsoil, it is defined as the basis of life and activity of all citizens of Russia who live on its territory, as well as their natural wealth [1].

Levochko V. believes that along with the subsoil plot, one of the most valuable and main objects of legal relations in the subsoil use system is the usage rights of the subsoil [2].

The above opinions emphasize the importance of high-quality regulation of proper protection and usage of subsoil.

Protection of the subsoil, according to K. R. Balakina, is a set of requirements, the fulfillment of which provides an opportunity to comply with a certain order of use of these natural resources [3].

Biryukov V. considers the issues of improving the institutions of environmental control and audit in the field of subsoil usage as factors contributing to reducing poverty and improving the quality of life [4]. The scientific literature notes that it is necessary to improve state and public environmental control [5; 6].

The subsoil, in accordance with the legislation of the Russian Federation, is the subject of joint jurisdiction of the Russian Federation and its subjects. The correlation between the current federal law and the law of the subjects of the Russian Federation regulating the subsoil usage is the main problem in these relations. In addition, the key problematic features of the legal regulation of the subsoil usage are, firstly, the division of powers between state authorities and, secondly, the coordination of the legislation of the subjects of the Russian Federation and the state itself [2].

According to Tolstykh N., the Subsoil Law has quite a large number of disadvantages, one of which is a very limited scope of its action: the norms are aimed at the legal regulation of relations arising in the process of granting the right of subsoil usage, the same relations that arise in the process of the subsoil usage in federal legislation are regulated fragmentally, in declarative form [7].

Article 23 of the Subsoil Law contains a list of basic requirements for the rational use of the subsoil, requirements for its protection, specifically paragraph 1, which is declaring the importance of observing the procedure for granting use and preventing unauthorized use of the subsoil. It refers to the norms of Article 11 of the Subsoil Law, which regulates the procedure for granting use of the subsoil, regardless of whether who provides it for use, federal authorities or authorities of the subjects of the Russian Federation. The license, which embodies a special state permit, contains such integral components as the State Emblem of the Russian Federation, graphic and other applications. They define the main conditions of subsoil usage.

Also, the Subsoil Law provides for the possibility of the subsoil usage without obtaining a license. Such cases may be, for example, a regional geological study, including regional geological and geophysical work, geological survey, engineering and geological surveys, scientific research, paleontological work, etc. The main condition is that these works should be directed to the general geological study of the subsurface, including earthquake forecasting and volcanic activity research, creation and monitoring of the state of the subsurface, the state of groundwater, and other work that excludes violation of the integrity of the subsurface.

Such works are carried out by state institutions under the control of the federal management body of the state subsoil fund or its territorial body. The basis of the work is a state task providing for the implementation of the state geological study of the subsoil.

The subsoil usage license does not allow the user to transfer the usage rights to someone else.

Based on the above, it can be concluded that licensing of the subsoil usage activities is an important mechanism for ensuring the provisions of Subsoil Law on the rational use of subsoil and environmental protection under state protection. However, this conclusion is not properly reflected in the norms of the Subsoil Law governing the procedure for obtaining a license to use subsoil plots.

Article 18 of the Subsoil Law establish a simplified procedure for granting the right to use subsoil plots, if we are talking about local works that are necessary specifically for the construction and maintenance of public highways. This determines the importance of the work carried out at the local level, affecting the proper development of infrastructure.

The legislative problem lies in the fact that this procedure does not contain specific norms that actually simplify obtaining a license for the subsoil usage to any extent. The only real consequence of using these standards is the construction of various industrial quarries.

This can be justified by the fact that the registration of licenses for the subsoil usage takes a long time. The period for obtaining licenses under this procedure reaches three years. This circumstance undoubtedly complicates the construction of highways in the terms stipulated by the relevant contract. Such a mechanism is inherent in large facilities with long-term contracts, with a significant amount of quarry development on the territory of one municipal district. And in the case of small objects with a few amounts of work on the development of subsurface resources and a short implementation period the use of such an order entails an impressive and inevitable increase in the cost of construction.

Thus, it would be advisable to amend article 19 of the Subsoil Law extending the effect of the article on organizations and individual businessmen when they execute contracts for the construction, repair and maintenance of highways.

It also makes sense to amend article 18 of the Subsoil Law to allow excavation for construction, repair and maintenance of public highways without transferring the land plots to industrial lands.

In order to obtain the right to use the subsoil for mining it is necessary to establish a notification procedure for the development of useful minerals. In this case, the contractor under a state or municipal contract preparing a package of documents to the municipality at the location of the land plot and receiving the appropriate permission sends a notification to the Ministry of Natural Resources of the subject of the Russian Federation. After receiving the documents, the agency monitors the contractor's extraction of the relevant generally useful minerals.

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MODERN TECHNOLOGIES OF MUNICIPAL SOLID WASTE INCINERATION

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Abstract. The paper discusses the methods of waste disposal and storage, focuses on modern technologies for incineration of municipal solid waste (MSW), provides their pros and cons, and describes examples of waste incineration plants located in Russia. The volumes of MSW burned in different countries are compared. The assessment of the waste processing technologies used in Russia is given, measures aimed at the disposal of numerous landfills polluting the environment are proposed.

Keywords: incineration, pyrolysis, municipal solid waste.

СОВРЕМЕННЫЕ ТЕХНОЛОГИИ СЖИГАНИЯ ТВЕРДЫХ КОММУНАЛЬНЫХ ОТХОДОВ

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Аннотация. В работе рассматриваются способы утилизации и хранения отходов, делается акцент на современные технологии сжигания твердых коммунальных отходов (ТКО), приводятся их плюсы и минусы, а также описываются примеры мусоросжигающих заводов, расположенных в России. Осуществляется сравнение объемов, сжигаемых ТКО в разных странах. Дается оценка применяемым технологиям переработки отходов в России, предлагаются меры, направленные на утилизацию многочисленных мусорных полигонов, загрязняющих окружающую среду.

Ключевые слова: сжигание, пиролиз, твердые коммунальные отходы.

The issue of waste disposal is extremely relevant in the modern world, since the population of many countries is concerned about global environmental problems that are directly related to the storage and processing of MSW, the volume of which is increasing every year. It is worth noting that in Russia approximately 70 million tons of municipal solid waste are generated annually – 90 % of them are sent to landfills and unauthorized landfills, which reduces the possibility of using large land areas for other needs, and entails a number of negative consequences, such as: soil pollution, groundwater and atmosphere [1, p.130].

Currently, no more than 10 % of MSW is received for processing and incineration, mainly garbage formed as a result of the activities of the population, as well as items and goods that have lost their consumer properties. This disappointing statistic makes us think about solving the issue of recycling MSW [2].

Consider the methods of disposal and storage of municipal solid waste.

1. Burial at landfills

The landfill is a complex of structures designed for centralized disposal of MSW and prevention of environmental pollution according to modern rules and standards [3].

The undoubted advantage of landfill burial is the cheapness of this method due to the lack of sorting costs. As well as convenience for the consumer, since there is no need to sort the garbage yourself and take it to specialized places. However, the disadvantages of this method far exceed the advantages. The burial of MSW causes enormous damage to nature. Decomposing garbage releases toxic substances that pollute the environment. The economic benefit is not realized, since some of the garbage could be partially recycled or used as fuel. This method of disposal is not modern and dangerous for both nature and man [4].

2. Recycling

Recycling is the reuse of materials that have already been used. This method allows rational use of resources and has less impact on the environment, the amount of toxic emissions is reduced. Today, enterprises engaged in waste processing receive state financial support [5].

The disadvantages of this method are large initial investments to start production, as well as the costs of sorting and transporting MSW.

3. Pyrolysis

Pyrolysis is a process of thermal decomposition of waste both sorted and not sorted without oxygen access. Because of pyrolysis, the organic part of the waste decomposes, while forming a combustible gas, a liquid fraction and a solid carbonaceous residue.

There are several types of pyrolysis depending on temperature – low-temperature (up to 550 °C), medium-temperature (up to 800 °C) and high-temperature (over 800 °C). Let's take a closer look at each type of pyrolysis.

A low-speed process characterizes low-temperature pyrolysis. It is worth noting that it does not provide complete thermal decomposition of some

materials, so it should be used for already sorted MSW. Because of the low-temperature pyrolysis process, a large amount of coke-ash residue is formed. The requirements for the organization of the process with this method of recycling MSW are relatively simple, which is an undoubted advantage.

Medium-temperature pyrolysis is optimal for waste disposal, since when it is used, a much larger number of materials are already subject to thermal decomposition, and the rate is significantly higher than in the first case. This process also does not require complex structural solutions [15, 16, 17, p. 6].

High-temperature pyrolysis is the most effective. During the process, the most complete decomposition of waste occurs at high speed. The disadvantage of this method is the complexity and high cost of equipment, the task of which is to ensure high temperatures. When using this method, there are significantly more advantages than disadvantages: minimization of environmental pollution, the possibility of recycling difficult-to-dispose of garbage; pyrolysis waste does not contain harmful substances, which allows their safe burial underground; there is no possibility of recovery of heavy and harmful metals [7].

4. Burning

Incineration is one of the most common methods of waste disposal. Using this method, it is possible to neutralize waste by reducing its volume by 10 times, and its mass by 3 times, and at the same time it is useful to use the resulting thermal energy. Incineration has a number of significant disadvantages, these include: the presence of harmful substances in flue gases – sulfur, nitrogen, carbon monoxide, hydrogen chloride and fluoride, fly ash, heavy metals, due to the presence of these components, expensive equipment is required for cleaning flue gases; waste sorting is necessary to reduce the amount of ash and slag, when burning unsorted waste, 20 % more slag is formed, and ash by 3%; when burning waste containing synthetic polymer materials (such as: bags, rubber, plastic, paint and varnish materials), dioxins and furans are formed (toxic substances dangerous to humans, and for nature).

To ensure safe incineration, many factors must be taken into account: sorting should be organized, expensive equipment should be purchased, cleaning systems should be provided, and local residents should be convinced of the safety of incinerators (MSZ). All these factors negatively affect the development of this industry, therefore, the presented method of recycling MSW is not so widespread. For example, there are only three incinerators in Moscow:

- special plant № 2 (Altufevskoe highway, 33a): the plant is the very first MSZ built on the territory of Russia and is capable of processing up to 160 thousand tons of waste per year and generating 17 million kWh of electricity per year;

- special plant № 3 (Podolsky Cadets str., 22a): the plant burns up to 360 thousand tons of garbage per year. The equipment of the Austrian company EVN AG makes it possible to receive up to 4 MW of electricity per year;

- special plant № 4 (Eastern Administrative District, industrial zone “Rudnevo”): the largest plant in Moscow and the Moscow region, it processes more than 750 thousand tons of garbage per year. The MSZ is equipped with

advanced flue gas purification technologies that meet the standards of European countries. In addition, it provides itself with thermal energy, and generates about 60 million kWh of electricity.

Let's consider the trends in the development of MSW incineration technology in foreign countries. In developed countries, a high level of garbage sorting has been achieved. In each yard, there are separate containers for collecting plastic, glass, paper, and food waste. Russia is still only at the initial stage of moving towards competent garbage sorting.

The number of incinerators is constantly increasing. There are 2,000 such facilities in the world, they process more than 280 million tons of garbage. In Japan, 80 % of all waste is incinerated, in France 35 % of garbage is incinerated, in Germany – 32 %, in the UK – 31 %, in Italy – 19 %, in the USA – 13 %, and in Russia only 3 % of waste is incinerated. Such a small percentage of burned garbage in Russia is explained by the fact that the country does not produce its own equipment for burning garbage. There is also an insufficiently developed culture of waste sorting, etc.

Based on the above, it can be concluded that the problem of waste disposal is very acute, and the sphere of MSW disposal will develop intensively. It is planned to build 550 new incinerators over the next 10 years.

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PROBLEMS AND SOLUTIONS FOR THE ELIMINATION OF EMERGENCY SITUATIONS AT THERMAL POWER PLANTS

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Abstract. The analysis of emergencies in the main buildings of thermal power plants, their causes and consequences. Possible causes of fires and the course of emergencies are analyzed on the example of thermal power plants.

Keywords: accident, fire, power plant, electricity, thermal power plant, TPP.

ПРОБЛЕМЫ И РЕШЕНИЯ ПО ЛИКВИДАЦИИ АВАРИЙНЫХ СИТУАЦИЙ НА ТЕПЛОВЫХ ЭЛЕКТРОСТАНЦИЯХ

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Аннотация. В работе проведен анализ аварийных ситуаций в главных зданиях тепловых электростанций, их причины и последствия. На примере тепловых электростанций анализируются возможные причины возникновения пожаров и ход аварийных ситуаций.

Ключевые слова: авария, пожар, электростанция, электроэнергия, тепловая электростанция, ТЭС.

A thermal power plant (TPP) is considered to be one of several major types of electricity generation. In the total volume of installed capacity, its share is 70 %.

The problem of combating fire safety at a power plant is very relevant today. At TPPs, power units are placed in one building as a convenience (polyblock layout solution). In terms of fire safety, this solution has a negative side - in case of an accident, the risk of fire spreading increases, which may eventually lead to equipment breakdown and failure of several TPP units.

The category of the premises according to the explosion and fire hazard of the TPP enclosure refers to buildings of the 1-2nd degree of fire resistance (SP

12.13130.2009 Determination of categories of premises, buildings and outdoor installations according to the explosion and fire hazard) [1]. The main building is a building that houses the main equipment of the TPP (gas turbine with air compressor, electric generator of the gas turbine, HRSG, steam turbine, main transformer), which ensures production of electric and thermal energy, auxiliary equipment (various installations for normal operation of the TPP – heat exchangers, slag removal systems, pumps, condensers, etc.), as well as service rooms. Figure 1 shows the structural diagram of the main building of the TPP.

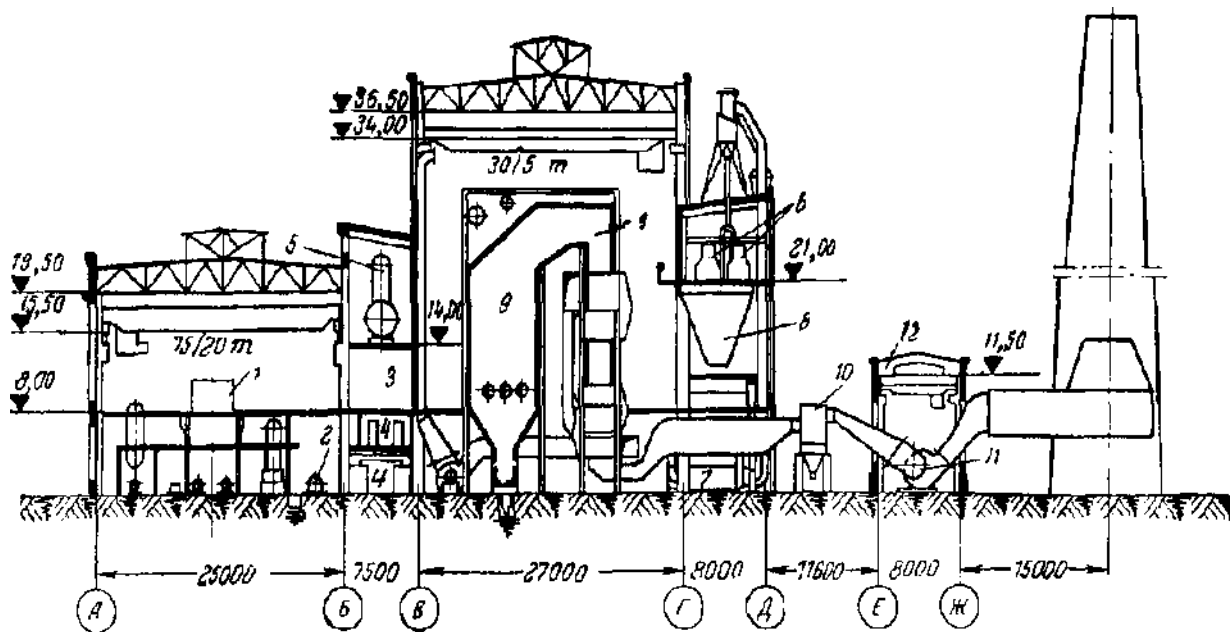


Figure 1. Scheme of the main building of the TPP

Over the last 20 years, combined cycle power plants (CCPPs) have been actively developed due to their high efficiency (up to 60 %) and low NO₂ and CO emissions, but for the time being, steam power plants have more advantages in production at thermal power plants [2].

A modern steam power plant includes the following facilities:

- production purpose;
- auxiliary production purposes;
- auxiliary facilities.

All objects are connected by engineering and transport communications.

In many domestic and foreign thermal power plants, all power units are located in one building - in the main building. This type of layout is called a poly unit layout. Such layout has Konakovskaya GRES (8x300 MW), Zainskaya GRES (12x200 MW), Shoaiba TPP in Saudi Arabia (5x400 MW), etc. Figure 2 shows views of the main building from the side of the engine room of Zainskaya TPP (a) and the engine room inside Zainskaya TPP (b) [2].



Figure 2. View of the main building from the side of the engine room of Zainskaya SDPP (a), view of the engine room inside Zainskaya SDPP (b)

The advantages of such placement in the main building compared to the monoblock housing are:

- Specific consumption of building structures and materials is reduced;
- The size of the industrial site on which the plant is located is reduced;
- Maintenance costs are reduced and reliability of equipment is increased;
- The amount of work in general on the improvement of the territory is reduced.

But there are also disadvantages, which are the reasons for the increased risk of fire spreading in some accidents, which can result in several TPP units being out of operation. Installation of fire partitions between the power units in the main building is not possible, so the fire can spread to the neighboring power units, resulting in the failure of all electrical equipment [2].

Over the last 5 years, about 8 major accidents with failure of several power units occurred at power plants [3].

Table 1 – Accident statistics for the last 5 years

<i>Date of accident</i>	<i>Name of power plant</i>
March 2, 2016	Ohinskaya CHPP
January 26, 2017	Penza CHPP-1
October 1, 2017	Yakutskaya GRES-1
February 3, 2018	Pervomayskaya CHPP-14
March 3, 2018	Smolenskaya CHPP-2
January 13, 2020.	Khabarovskaya CHPP-1
December 11, 2020	Lipetsk CHPP-2
December 23, 2021	Ulan-Ude CHPP-1

On December 23, 2021, an accident at Ulan-Ude CHPP-1 occurred as a result of a short circuit in the basement of the turbine house, a fire in the cable

compartment, interruption of fuel and fuel oil supply to the CHP unit, resulting in 6, 7, 8, 9 boilers and 6 and 7 turbine generators being shut down. In connection with this, heat and hot water supply to 70 % of homes and apartments was stopped. The elimination of the accident was successful, the emergency services and engineers and workers of CHPP-1 eliminated the consequences of the emergency [4].

According to statistics, 90 % of major accidents are caused by equipment failures and accompanied by fire; the remaining 10 % are a consequence of damage to building structures. Figure 3 shows the main places of fire emergence at the TPP.

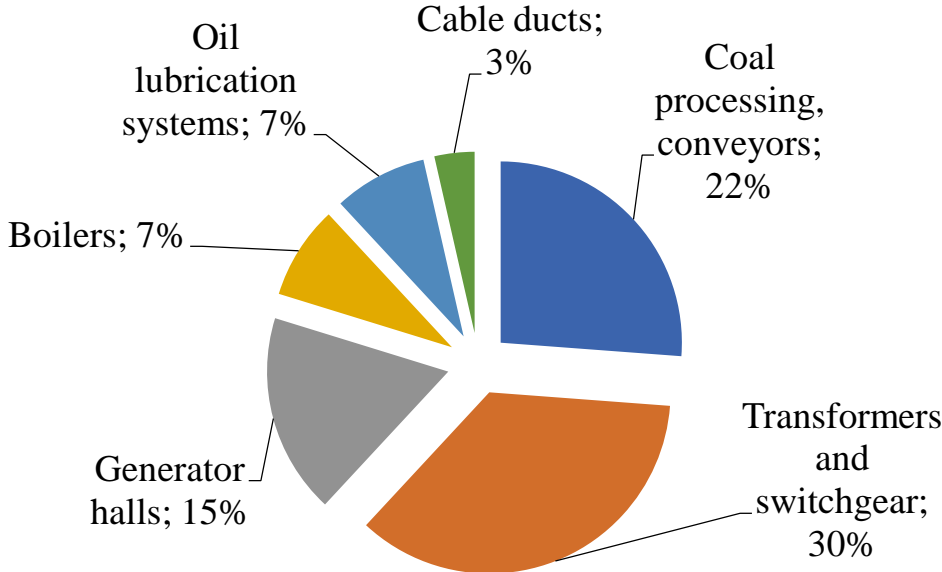


Figure 3. Common locations of fires at TPPs

The main causes of major accidents in the main buildings of TPPs:

1. Errors of operating personnel;
2. Mistakes in design and installation of building structures and facilities;
3. Faulty repair of main and auxiliary equipment;
4. Mistakes of ODU;
5. External factors.

At the initial stage of design of fire protection at TPPs, it is important to consider possibilities:

- Signal control of the fire-extinguishing system
- Operative recording of the system state on the ES control panels
- Reception of a signal from manual call points on the territory and on the premises of the power plant

- Training of all personnel to manage the evacuation of people in case of fire.

It is important to consider that fire safety should be carried out by highly qualified specialists, who must have all the skills and abilities, as well as understand all the features of work in the energy sector [5].

Today, the main building of the TPP is a hazardous production facility and is subject to compulsory insurance. The issue of accident insurance is still not considered necessary due to its unlikelihood, but it can contribute to the rapid recovery of damage. The problems that are associated with explosion and fire safety are still relevant to this day for the electric power industry in Russia.

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SELECTION OF REAGENTS FOR FLOCCULATION TREATMENT OF WASTEWATER CONTAINING BLACK LIQUOR

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Abstract. This paper presents the results of trial flocculation using flocculants C-497 HMW and C-444. The obtained dependences of the optical density on the dose of reagents are presented, and the dose at which the purification efficiency (within the framework of the experiment) is maximum is determined.

Keywords: flocculation, waste water of pulp and paper production, black liquor.

ВЫБОР РЕАГЕНТОВ ДЛЯ ФЛОКУЛЯЦИОННОЙ ОЧИСТКИ ЩЕЛОКОСОДЕРЖАЩИХ СТОЧНЫХ ВОД

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Аннотация. В статье приведены результаты пробного флокулирования сточных вод с использованием флокулянтов C-497 HMW и C-444. Получены зависимости оптической плотности от дозы реагентов, а также определена доза, при которой эффективность очистки (в рамках поставленного эксперимента) максимальна.

Ключевые слова: флокуляция, сточные воды целлюлозно-бумажного производства, черный щелок.

Flocculants are water soluble high-molecular compounds that, when introduced into the system, contribute to the enlargement of particles. The mechanism of their action consists in the formation of three-dimensional structures with particles capable of accelerated formation of flocs with better sedimentation properties [1].

Flocculation, according to ITD-8 (information and technical directory of the best available technologies), is both an independent physico-chemical method of wastewater treatment and a method of intensifying the extraction of substances from water that cannot be removed by non-reactive mechanical methods [2].

However, there is a certain problem – there are no calculation formulas for determining the optimal dose of flocculant, and therefore it is established using trial flocculation for each specific case [3].

The purpose of this work is to select a flocculant, as well as the selection of the dose at which maximum purification efficiency is achieved for wastewater containing black liquor.

As part of the study, model wastewater with a black liquor content of 10 g/l was prepared, as well as solutions of two polyacrylamide-based flocculants – C-497 HMW and C-444 – with a concentration of 0.1 %.

For trial flocculation, 100 ml of model water was taken into the cylinders, various pH values were created (from the initial to 3), after which the efficiency of water purification was photometrically determined.

The results obtained with the use of flocculant C-497 HMW are presented in Table 1.

Table 1 – Change in optical density with the introduction of C-497 HMW

<i>Nº</i>	<i>pH</i>	<i>D_{init}</i>	<i>D,</i> <i>(1 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(2 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(3 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(10 ml of</i> <i>flocculant)</i>
1	9,15	0,889	0,861	0,837	0,808	0,717
2	8,13	0,766	0,710	0,705	0,693	0,629
3	6,04	0,591	0,570	0,557	0,526	0,472
4	5,10	0,570	0,549	0,548	0,536	0,425
5	4,15	0,539	0,533	0,533	0,507	0,399
6	3,11	0,518	0,520	0,524	0,599	0,655

When the coagulant was introduced, no aggregation of particles was observed – the solution remained transparent. When measured on a spectrophotometer, a decrease in optical density was observed in all samples except the last one. The obtained dependencies are shown in Figure 1.

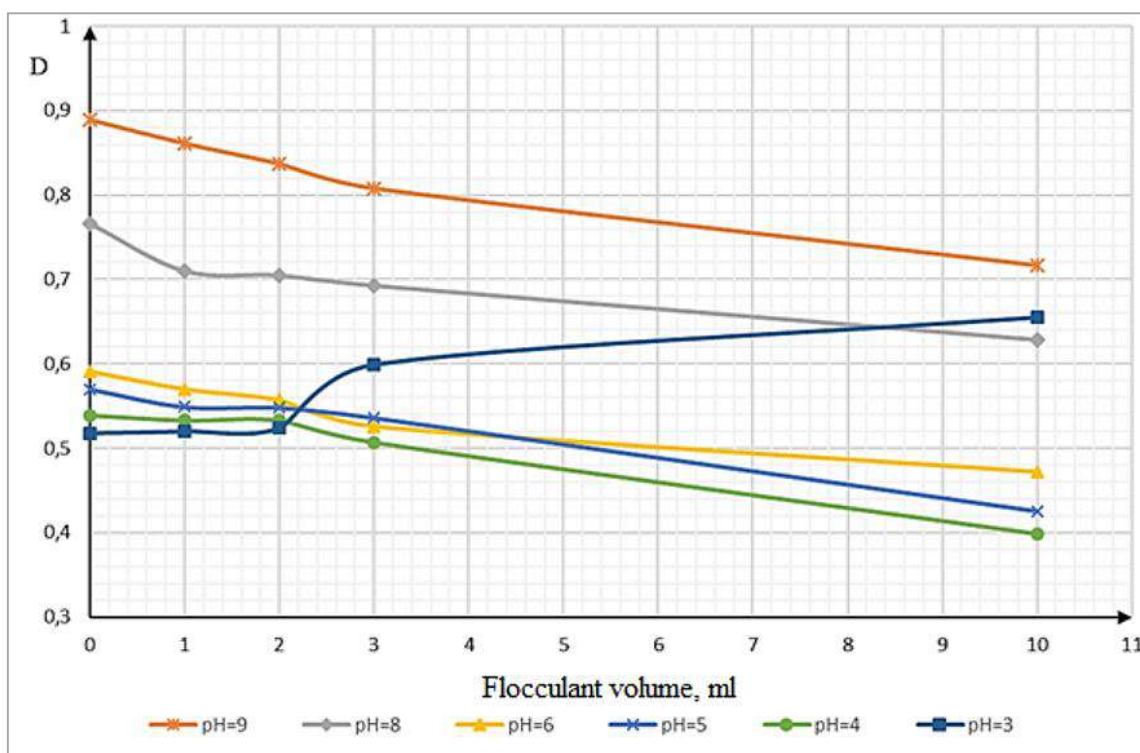


Figure 1. Change in optical density with the introduction of C-497 HMW

The results obtained with the use of the flocculant C-444 are presented in Table 2.

Table 2 – Change in optical density with the introduction of C-444

<i>N_o</i>	<i>pH</i>	<i>D_{init}</i>	<i>D,</i> <i>(1 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(2 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(3 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(10 ml of</i> <i>flocculant)</i>	<i>D,</i> <i>(10 ml of</i> <i>flocculant,</i> <i>after</i> <i>filtration)</i>
1	9,15	0,894	0,893	0,896	0,902	1,385	0,772
2	8,11	0,769	0,824	0,820	0,820	1,357	0,395
3	6,18	0,586	0,624	0,681	0,750	1,334	0,362
4	5,13	0,569	0,595	0,610	0,639	1,139	0,192
5	4,05	0,538	0,557	0,578	0,599	0,927	0,115
6	3,17	0,524	0,563	0,598	0,617	0,898	0,155

When the coagulant was administered, there was also no aggregation of particles, but the optical density gradually increased (Figure 2).

When a 10 ml dose of coagulant was administered, the solution in all cylinders became very cloudy, the optical density increased greatly. Aggregates visible to the eye were formed, which, however, were poorly sedimented – the particles remained suspended for 30 minutes.

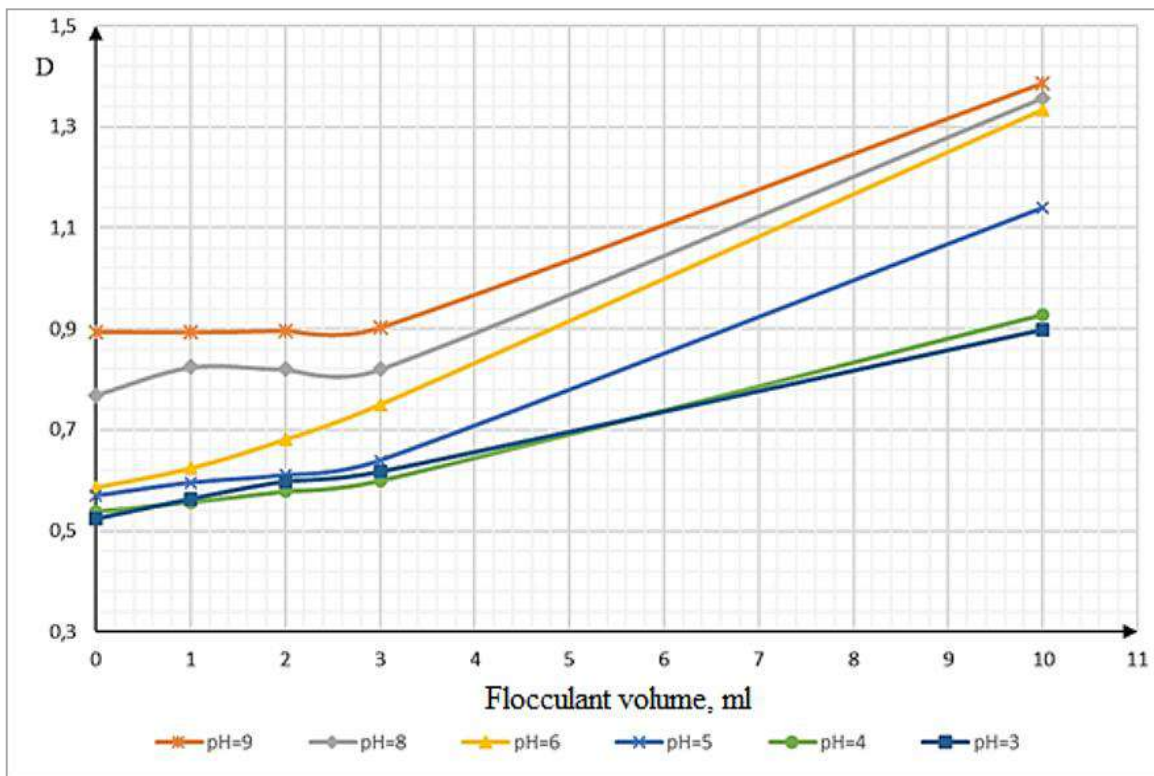


Figure 2. Change in optical density with the introduction of C-444

After filtering the samples, the optical density was measured again. Comparison of the optical density of the initial and optical density after administration of 10 ml of flocculant and filtration are shown in Figure 3.

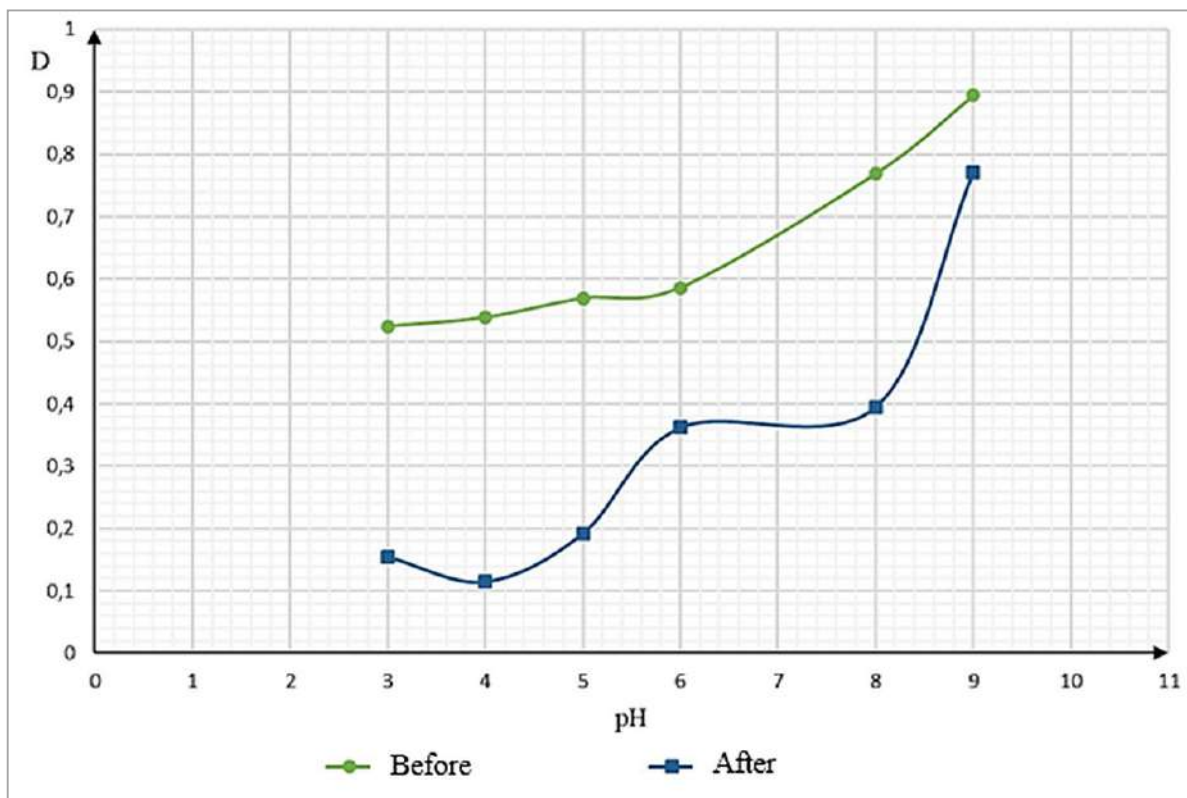


Figure 3. Comparison of optical density before and after filtration

As can be seen from the graph (Fig. 3), the greatest effect is observed at pH = 4 – the optical density decreased by 78.6 %. However, the effect was observed only at a high dose of the reagent – 10 ml of 0.1 % flocculant C-444 per 100 ml of purified water. Despite the relatively low cost of C-444 flocculant (from 210 rubles / kg) [4], the use of such a dose is economically impractical. In this regard, it is necessary to continue research, but at lower concentrations of the reagent.

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ABEFFICIENCY OF USING MODERN WATER PURIFICATION TECHNOLOGIES AT THERMAL POWER PLANTS

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Abstract. The article presents promising methods of water purification at thermal power plants, considers the effectiveness of modern water purification technologies and the possibility of their application in production. The advantages and disadvantages of each method and the principle of its operation are analyzed.

Keywords: thermal power plants, reverse osmosis, ion exchange, electrocoagulation, electromagnetic treatment.

ЭФФЕКТИВНОСТЬ ИСПОЛЬЗОВАНИЯ СОВРЕМЕННЫХ ТЕХНОЛОГИЙ ОЧИСТКИ ВОДЫ НА ТЭС

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Аннотация. В статье представлены перспективные способы очистки воды на теплоэлектростанциях, рассмотрена эффективность современных технологий очистки воды и возможность их применения на производстве. Проведен анализ достоинств и недостатков каждого метода и принцип его действия.

Ключевые слова: тепловые электрические станции, обратный осмос, ионный обмен, электрокоагуляция, электромагнитная обработка.

Water quality in reservoirs of various scales is a very acute problem for humanity. The most important industry in this matter is energy. A large amount of impurities in the water causes enormous damage to thermal power plants,

water supply systems and heating systems. In order to reduce the harmful effect on the systems, complexes for water purification are installed. Subsequently, this water is used for the production of electrical and thermal energy.

The treatment facilities installed at the stations are significantly outdated, which reduces the efficiency of their work. Currently, the most effective water purification technologies have been developed. In this paper, an analysis of the efficiency of using modern water purification technologies at thermal power plants is carried out.

At the thermal power plant, water is used to fill the steam turbine circuit and to compensate for steam losses both inside the station and for external consumers. Desalinated water can solve this problem. Preparation of unsalted water at modern power plants can be carried out in various ways.

The most common application is the ion exchange method. The essence is to use the ability of ionites to change the ionic composition of water impurities. In this method, the sorption of a solution of ions of one type is accompanied by the transition of ions of another type previously absorbed into the solution.

The advantages of this method are obtaining high-quality water, reducing the content of liquid salts not only in liquids, but also in other harmful substances, ease of use.

The disadvantages include the high cost of extracting chemical reagents and the need for proper disposal of the reagents used. However, in advanced systems, all the disadvantages become almost invisible, since the consumption of reagents in them is slow, and thanks to special catalysts, the water purification process is significantly increased [1].

The reverse osmosis method is one of the most modern methods and consists in the principle of passing water molecules through a semipermeable membrane under the influence of external pressure. Thus, up to 98% of impurities dissolved in water can be removed.

The reasons for the widespread use of this method include: a high degree of water purification, low operating costs of installations, as well as compact dimensions compared to other water purification technologies. Reverse osmosis systems include filters that provide mechanical and chemical cleaning. There is no need to buy additional equipment [2].

The disadvantages of water purification by reverse osmosis include the inability of the membrane to retain volatile chlorine and other gaseous impurities. However, this disadvantage is eliminated by a multi-stage cleaning system that includes carbon filters.

Electrocoagulation is a method of water purification that uses direct current on electrodes immersed in water. In the process, the electrodes gradually dissolve, metal ions react with impurities, forming clots in the form of flakes, which are easily removed from the water.

The advantages include a high degree of cleaning, simple design of the device, tightness and ease of use.

The disadvantages are low productivity, energy costs, a large amount of slag at the end of the process, the formation of waste that is not recyclable [3].

One of the important problems of water purification is disinfection. UV technology is used for this. UV water purification is a very effective method of disinfection without the use of chemicals or heat treatment. This treatment method is more suitable for wastewater treatment, which subsequently flows from production back into the ecosystem [4].

Advantages of such water purification: minimal operating costs, ease of use and maintenance of UV devices.

The disadvantage of the method is that after UV treatment, the water moving in the tube is subjected to repeated microbiological contamination. To avoid this, a combination of ultraviolet radiation and chlorination is required.

The next type of purification at thermal power plants is electromagnetic water purification. This method is the effect of a magnetic field on water, where dissolved calcium, silicon and magnesium ions lose their ability to form salts on the surface of the sorbent. The water obtained by such treatment retains its salt composition and does not form secondary properties.

The advantages include the durability of such devices, increased heat transfer in heating systems, as well as an increase in filtration rate.

The disadvantage is that magnetic treatment does not allow to completely purify the water, additional methods and methods of purification are required to obtain high-quality water [5].

After analyzing various methods of water purification in industry, we come to the conclusion that not all methods are effective. The choice of the water treatment method depends on the quality of the source water, the equipment installed at the thermal power plant, as well as on the economic justification for the modernization of the existing water treatment scheme at the stations.

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APPLICATION OF MACHINE LEARNING IN THE ENTERTAINMENT INDUSTRY

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Abstract. The paper discusses the principles of the application of machine learning and artificial intelligence. Two cases of the use of artificial intelligence on the examples of popular Internet services are considered.

Keywords: artificial intelligence, AI, machine learning, tasks, application.

ПРИМЕНЕНИЕ МАШИННОГО ОБУЧЕНИЯ В ИНДУСТРИИ РАЗВЛЕЧЕНИЙ

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Аннотация. В работе рассматриваются принципы применения машинного обучения и искусственного интеллекта. Представлены два способа применения искусственного интеллекта на примерах популярных интернет-сервисов.

Ключевые слова: искусственный интеллект, ИИ, машинное обучение, задачи, применение.

In modern times machine learning is becoming increasingly popular and introduction of artificial intelligence has become an essential part of various areas of our life. Artificial intelligence (AI) is becoming more complex, every day it carries out more and more difficult tasks. One of the applications of AI is prediction. At the moment, prediction is getting more and more popular issue of modern society.

Prediction with AI is used in various areas of science and economic. For example, in medicine AI predicts probability of a heart attack in a patient; in economics, AI is able to predict the rise or fall of stocks in the stock market; AI can predict the weather in the coming hours with the highest accuracy; online stores predict which products and services will be needed by the customer [1].

Now, for a successful existence, a modern video service or video hosting must have a well-thought system of recommendations. The service predicts which content will interest the user. Basically, recommendations are needed just for a quick search for interesting videos / movies by the user.

Let's look in detail at the methods which the video hosting YouTube and the Netflix streaming service use to implement their recommendation system.

The main page of the Netflix streaming service shows a catalog with suggested films. The probability that you decide to watch a particular video from the catalog is evaluated based on many specific factors. The specifics of your interaction with the service are considered (viewing history and ratings given to other videos); the choice of other users of the service with similar tastes and preferences; characteristics of the film or series itself: genre, type, cast, year of release etc. Besides information concerning what exactly the user watches, data is also used about how the viewing takes place, that is, at what time of day, by which devices and how long. Also, at the beginning of using the video service, the user selects from the suggested list several films and series that attracted him. All these parameters and data are evaluated and processed by a specific algorithm [2].

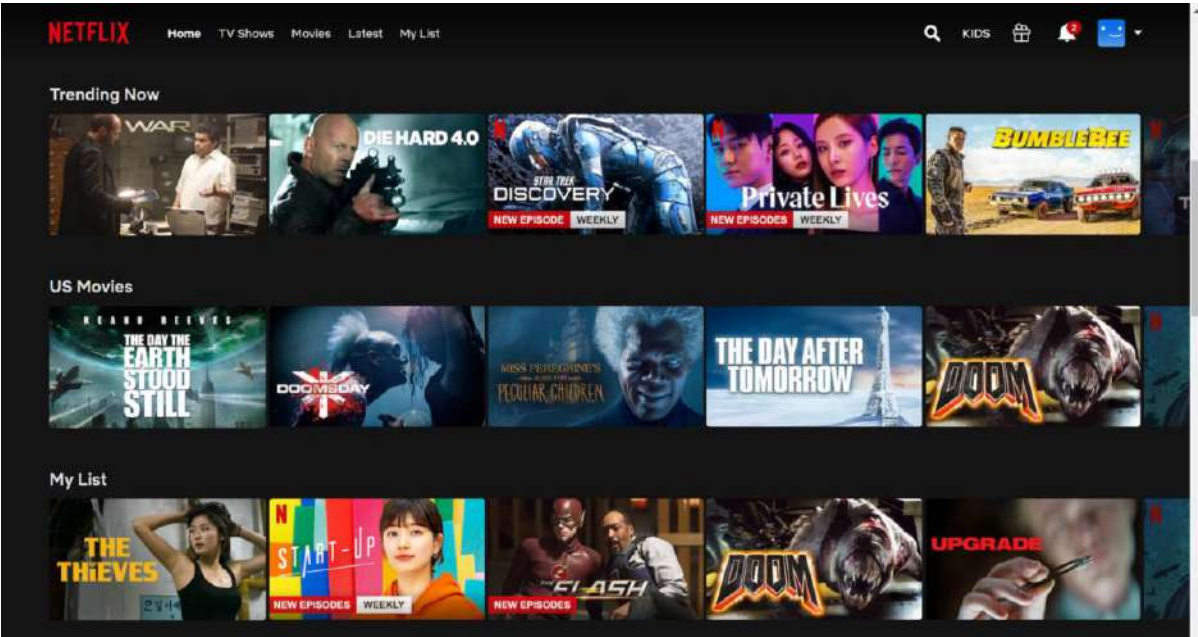


Figure 1. Netflix recommendation page

YouTube video hosting, due to the similarity of the directions of the services, uses exactly the same data to predict recommendations. But there are several additional sources of data. Let us look at some examples.

Mouse clicks. When you click on a video, it probably means that it will look interesting to you.

Viewing time. By analyzing which videos the user has viewed and for how long, the system receives personalized signals about which content the user is likely to enjoy.

Survey results. In order to determine for sure, whether the viewer is satisfied with the content he has watched, the system takes into account the so-called “valuable viewing time”.

The author's credibility is also evaluated, the higher this indicator is, the more the system will push the content of this author [3].

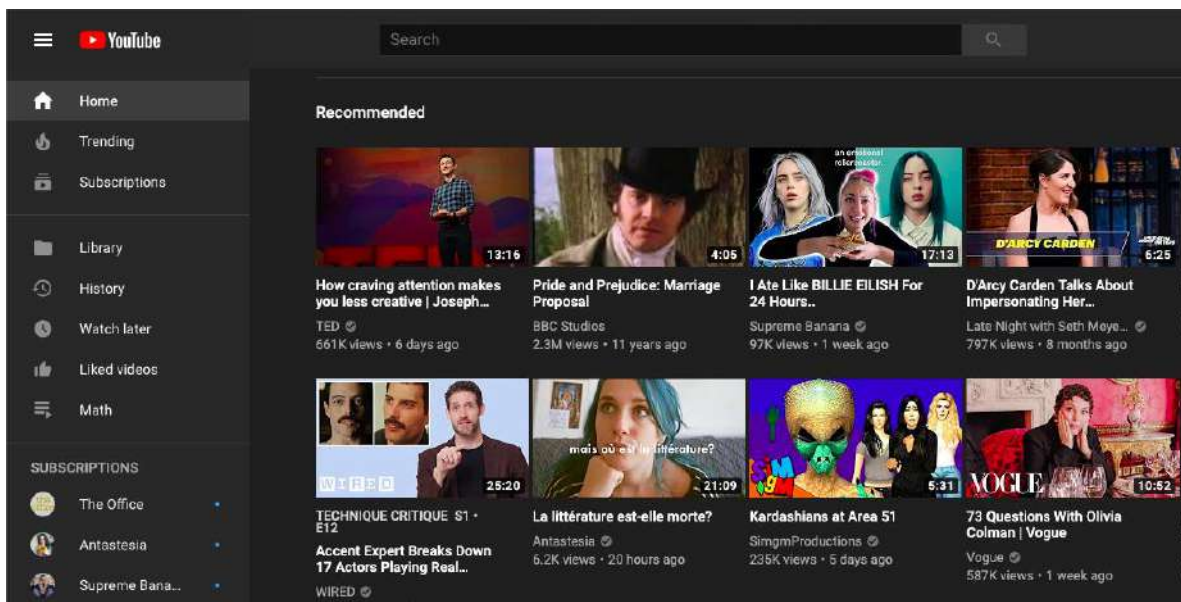


Figure 2. YouTube recommendation page

Now consider the social network Facebook. The essence of the Facebook algorithm is that it controls the formation of the news feed so that it most accurately for the user's requests.

Instead of displaying content in chronological order, the news feed and ads are published based on what Facebook considers relevant to you as a user.

Facebook's algorithm gives priority to publications that attract attention, so the publication time factor is very important. To increase engagement, brands should stick to a content calendar that chooses the best time to post on social media [4].

Facebook executives noted that video content increases user engagement and interaction compared to any other type of content on the platform.

Meanwhile, the recent video rating update once again highlights the importance of native video on Facebook. The leading positions were taken by high-quality original video, which people watch for more than 1 minute. Especially appreciated were the videos that held the attention for more than 3 minutes. Facebook has also started publishing posts and content from “close friends” – who people interact with most often by tagging each other in photos or sending messages to Messenger. Added a new feature “Why I see this post”, which explained why this particular content is displayed in the user's feed.

And like YouTube algorithms, facebook began to evaluate the reliability and quality of news articles in order to promote truthful information and get rid of fakes. And people were seriously worried about the privacy of their data – the appearance of relevant advertising out of nowhere was frightening.

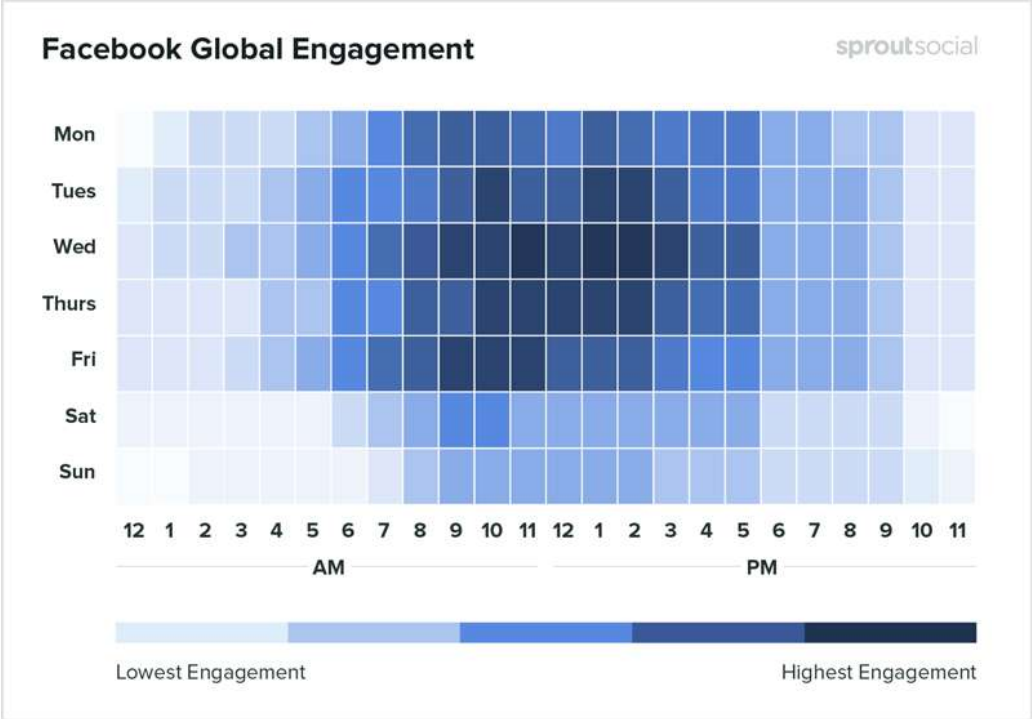


Figure 3. Facebook Global Engagement

Unfortunately, now the algorithm code is hidden by companies, so it is not available to analyze its work.

Today machine learning is discovering more and more application areas. Over the past few years, AI has been successfully applied in many areas of modern society, one of them is the entertainment industry, at this stage of its popularization, it is impossible to imagine services which do not use machine algorithms.

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DESIGNING A VESSEL WITH HYDROGEN FUEL CELLS PROPULSION

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Abstract. This paper discusses perspectives of hydrogen fuel, its advantages and disadvantages and demonstrates a way to use hydrogen fuel cells for propelling a dry cargo vessel.

Keywords: hydrogen, fossil fuel, fuel cell, cargo vessel, design.

ПРОЕКТИРОВАНИЕ СУХОГРУЗНОГО СУДНА С ПРИМЕНЕНИЕМ ВОДОРОДНЫХ ТОПЛИВНЫХ ЭЛЕМЕНТОВ

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Аннотация. В работе рассматриваются перспективы водорода как топлива, его достоинства и недостатки, а также демонстрируется возможное применение при проектировании сухогрузного судна.

Ключевые слова: водород, ископаемое топливо, топливный элемент, сухогрузное судно, проектирование.

At present, global climate changes have become one of the most important problems. The alteration of temperatures and precipitation levels are already visible – the average temperature all over the Earth is said to have increased since 1900 by almost 1 °C. The main sources of air pollution, to which these changes are attributed, are usually divided into natural and anthropogenic, with transport taking the major part of the last group. Various emissions generated by transport are the main source of pollution in industrialized countries. The use of coal and gasoline results in carbon dioxide emissions. Therefore, one of the ways to tackle the growing environmental problems is a search for alternative fuels [1].

Alternative fuels are considered by ecologists to be pure and eco-friendly, as they don't result in emissions and pollution and have no other harmful effect on the environment. For example, such devices as solar panels are believed to be ecologically pure; however, though they do not give off any dangerous

emission, active use of these panels leads to the average temperature increasing in the area and to a change of microclimate as a result [2].

One of the most environmentally friendly and promising kinds of fuel is hydrogen. Compared to other types of fuels such as gasoline, natural gas, coal, etc, hydrogen has a number of significant advantages.

First of all, every vehicle has to carry its fuel a certain distance before the next supply. Consequently, it is important for fuel to be as light as it possible and not take too much space. For an estimate of all these characteristics, we can take a dimensionless quantity called the driving force factor:

$$\Phi_M = \frac{\left(\frac{E}{M}\right)\left(\frac{E}{V}\right)^{2/3}}{\left(\frac{E_h}{M_h}\right)\left(\frac{E_h}{V_h}\right)^{2/3}},$$

where E – energy produced by the fuel,

M – mass of the fuel,

V – volume of the fuel,

h – hydrogen.

Table 1 – Driving force factor of different kinds of fuels

<i>Fuel</i>	<i>Chemical formula</i>	<i>Mass specific heat of combustion, (E/M), J/kg</i>	<i>Volume specific heat of combustion, (E/V), J/m</i>	<i>Driving force factor, Φ_M</i>
Liquid fuels				
Fuel oil	C ₂₀ H ₁₂	45.5	38.65	0.78
Gazoline	C _{5 10} H _{12 22}	47.4	34.85	0.76
Jet fuel	C _{10 15} H _{22 32}	46.5	35.30	0.75
Liquefied carbon gas	c	48.8	24.40	0.62
Liquefied nature gas	~CH ₄	50.0	23.00	0.61
Methanol	CH ₃ OH	22.3	18.10	0.23
Ethanol	C ₂ H ₅ OH	29.9	23.60	0.37
Liquefied hydrogen fuel	H ₂	141.9	10.10	1.00
Gas fuel				
Nature gas	~CH ₄	50.0	0.040	0.75
Hydrogen fuel	H ₂	141.9	0.013	1.00

The higher the driving force factor, the better the fuel is for transportation.

Another important advantage of hydrogen is its versatility. Comparing to other kinds of fuel, hydrogen can be converted into a greater number of different forms of energy. Standard fossil fuels can only be converted into other forms of energy in the combustion process, which hydrogen can be converted into

electricity directly. This makes it the most versatile sort of fuel and, consequently, the most efficient one. Various studies have shown that hydrogen is not as resource-intensive as fossil-fuels.

Table 2 – Efficiency of fossil fuels compared to that of hydrogen

<i>Usage</i>	<i>Efficiency</i> $\frac{\eta_{foss.}}{\eta_H}$
Flame combustion	1.00
Catalytic combustion	0.80
Vaporization	0.80
Electric energy	0.54

Hydrogen is also a safer fuel than any other. Neither hydrogen itself nor its combustion products, which have the form of water vapor, are toxic. It should be noted that the fiery combustion of hydrogen may lead to forming nitrogen oxides, which do have a toxic effect, but, on the other hand, this combustion doesn't produce carbon oxides that cause significant harm to the environment.

The explosiveness and fire hazard of hydrogen are due to its low energy and high flammability limits. This chemical element also reacts easily with oxidizing agents, which leads to the release of large amounts of heat. Nevertheless, the combustion process goes really fast and its flame is directed upwards which is why hydrogen has less destructive power than gasoline, for example [3].

All this makes hydrogen a promising fuel for the future as it is one of the most optimal, versatile and safe transport fuels.

There are two principal methods of using hydrogen as a fuel, the first of them being burning it as a combustible fuel. However, as has been said above, combustion of hydrogen in open air leads to a release of nitrogen oxides which, though not as dangerous as carbon oxides, are still rather harmful for the environment. The second way is to use hydrogen in fuel cells.

It is a relatively new approach and it is considered one of the most promising. The working principle is based on electrochemical reaction in which atoms of hydrogen decompose into electrons and protons. The fuel cell contains two chambers: the anode and the cathode. Hydrogen enters the anode chamber, while oxygen which is being taken from the air, goes to the cathode chamber. As a result of hydrolysis reaction hydrogen in the anode chamber combines with oxygen and turns into water vapor. The electrons that are released at the output give electricity.

Such an engine has some important advantages: high efficiency, complete noiselessness due to the absence of moving parts, complete absence of harmful emissions and high autonomy. Its main disadvantage is its high cost (even though hydrogen consumption is several times less than that of gasoline) due to the lack of hydrogen infrastructure not only in Russia but around the world as well. Hydrogen is needed to be produced and stored in such amount which

would be enough for all its consumers. That's why fossil fuel engines are still widespread.

Despite that, there are some attempts to use fuel cell engines, and of them is the further described dry-cargo vessel of an unlimited navigation area, carrying general cargo. Its main characteristics are given in the following table.

Table 3 – The vessel main characteristics

<i>Characteristic</i>	<i>Measure</i>	<i>Value</i>
Length	m	95,0
Length between perpendiculars	m	93,2
Breadth	m	15,5
Draught	m	5,50
Speed	kn	13
Cargo capacity	m^3	7,123
Autonomy	days	40

The universal dry-cargo vessel designed by the bureau “Vostok” was chosen as the prototype. This choice was determined by the following factors:

1. Transport vessels are large enough to be able to accommodate the equipment that allows to use hydrogen fuel cells.
2. Significant volume of commercial shipping in Russia takes place in Northern regions (Baltic and North Seas), where harmful emissions requirements are being tightened.
3. Transport vessels as objects of maritime infrastructure are the most common and demanded [4].

The designed vessel has an electric propulsion plant and uses two electric rudder propellers in the stern to provide maximum capacity of cargo holds.

The use of a propulsion system on fuel cells reduces the engine room size, thus enabling the use of an inverted bow and moving all the rooms there. This frees up a large amount of space at the stern, which can be used for additional cargo. The fuel cells system converts hydrogen fuel, which comes from cryogenic plants containing liquid hydrogen, into electrical energy. The output electricity feeds rudder propellers and all the vessel devices and systems. The power plant only emits water vapor, which is not harmful for the environment.

As an emergency power source dry-cargo vessel has a diesel generator.

Calculation of the water resistance and towing power was done according to the Halltrop method and is presented in the table [5].

Table 4 – Calculation of water resistance be the Halltrop method

Final calculations of resistance by a method Holtrop-1988

Speed [kn]	Speed [m/s]	Fr [-]	R _f [kN]	R _r [kN]	R _T [kN]	Power [kW]	R _{T_e} [kN]	Power _e [kW]
5.00	2.57	0.084	16.4	3.9	20.3	52.1	20.3	52.1
6.14	3.16	0.104	24.0	5.9	29.9	94.5	29.9	94.5
7.29	3.75	0.123	33.0	8.3	41.4	155.0	41.4	155.0
8.43	4.34	0.142	43.4	11.5	54.9	238.0	54.9	238.0
9.57	4.92	0.161	55.0	16.2	71.1	350.3	71.1	350.3
10.71	5.51	0.181	67.9	23.4	91.3	503.2	91.3	503.2
11.86	6.10	0.200	82.1	35.0	117.1	714.1	117.1	714.1
13.00	6.69	0.219	97.5	53.3	150.8	1008.6	150.8	1008.6
14.00	7.20	0.236	112.0	76.0	188.0	1354.0	188.0	1354.0
15.00	7.72	0.253	127.4	107.1	234.6	1810.0	234.6	1810.0

The drawing of general arrangement of the designed vessel is in Figure 1.

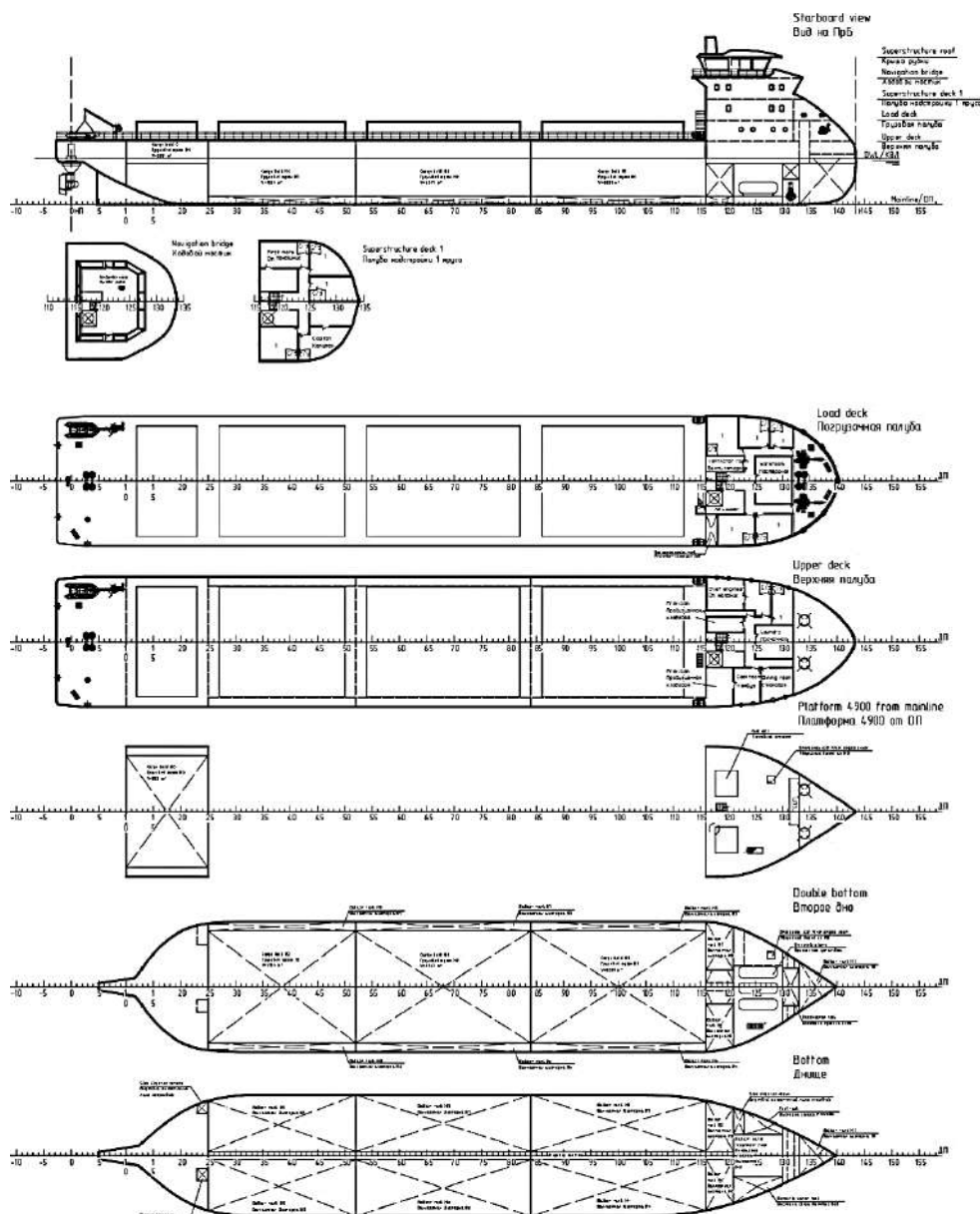


Figure 1. General arrangement

Outwardly, the designed ship doesn't differ really much from similar dry-cargo ships using fossil fuels. However, the high efficiency of hydrogen fuel cells, their small size and ease of maintenance bring major changes into the general arrangement. A dry-cargo vessel of similar dimensions using a traditional diesel engine would have an aft engine room. In this case the volume of holds would only be 6.166 m³ compared to 7123 m³ of the designed vessel.

Despite the fact that the use of hydrogen as a fuel today is difficult due to a number of practical obstacles, such as the absence of hydrogen infrastructure and the lack of its production on industrial scale, it is clear that hydrogen is very promising and may be a widespread fuel in the future.

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USING MICROSERVICE ARCHITECTURE IN SOFTWARE DEVELOPMENT

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Abstract. This article discusses microservice architecture, which in recent years has become one of the most popular architectures in software development, the history of its development, the reasons for its wide use in software development. The article also describes advantages and disadvantages of microservice architecture and development requirements. After reading the article you will learn about microservices, the history of their origin, common problems and ways to solve them. At the end of the article you will find examples of problems and solutions.

Keywords: microservice, microservice architecture, service, monolithic application, horizontal scaling, logging, user request.

ИСПОЛЬЗОВАНИЕ МИКРОСЕРВИСНОЙ АРХИТЕКТУРЫ ПРИ РАЗРАБОТКЕ ПРОГРАММНОГО ОБЕСПЕЧЕНИЯ

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Аннотация. В данной статье рассматривается микросервисная архитектура, которая в последние годы стала одной из самых популярных архитектур при разработке программного обеспечения, история его развития, причины его широкого применения в разработке программного обеспечения. Описываются преимущества и недостатки микросервисной архитектуры, требования к разработке. Представлена информация о микросервисах, истории возникновения, часто возникающих проблемах и о путях их решения.

Ключевые слова: микросервис, микросервисная архитектура, сервис, монолитное приложение, горизонтальное масштабирование, журнал логов, пользовательский запрос.

Introduction

There are many kinds of software architectures today. All of them are different, each has its own features. But they have one thing in common – when compared to each other they all have advantages and disadvantages.

Let us consider a microservice architecture, what it is, what features it has, what problems arise when using microservices and how to solve them.

Where did microservices come from?

Before microservices, monolithic applications were used. But in 2005, at the Cloud Computing conference, they started talking about the problems of using monolithic applications. The problems of such applications were: fault tolerance, horizontal scaling, using only one technology, difficulties in working in a development team, refactoring difficulties, slow implementation speed and functionality, difficulties in testing and commissioning, in adjusting to business requirements.

The term “microservices” took hold in 2011 in software development. Microservices provided the necessary lightness and flexibility. In 2012, the term was finally adopted [1].

What is a microservice?

Microservices, i.e. microservice architecture, is an architectural style that builds an application as a set of autonomous and collaborative services. Services should be built so that they are minimally dependent on each other and are not highly interconnected. Services should interact using open publicly available interfaces (APIs). And interfaces should hide internal details and functions. Inside a single service there should be all interconnected functions. Also, services should have a limited context.

Why use microservices?

Microservices eliminate most of the drawbacks of monolithic applications, make it easier to manage large applications that are divided into many small services, and make them easy to scale.

Advantages of microservices:

- Ease and speed of deployment;
- Interchangeability;
- Retention of modularity;
- Scalability independence;
- Independence of technical stack;
- Independence of subsystem evolution;
- Development independence;
- Failure isolation;
- Decentralization of data;
- Reusability.

Disadvantages of microservices:

- Distributed transactions;
- Difficulty in finding errors;
- Difficulty of fixing errors;
- Difficult to maintain;
- Difficulty of operation;
- Difficulty of interacting with other services [2].

Requirements for microservices

A service should be made small enough to perform a specific task, but also large enough so that interaction with other services is minimal.

The development team should be small in order to remain autonomous. If the team is large, it spends a large amount of time discussing work issues and problems. Amazon takes a “team on two pizzas” approach. This approach implies that there are enough 2 pizzas to feed the entire team [3].

Each service must be developed and deployed separately from the others. Also, each service must have its own database. Having one database for all does not allow to deploy services separately. And this already violates the principle of independence of services.

In the case of failure of one or more services, the remaining services must work and not fail. To achieve fault tolerance, it is necessary to minimize the interaction between the services.

Each service is required to have its own separate repository. The services are deployed separately, so it is necessary to keep the code of each service separately from the others.

It is necessary to integrate the working code with the main branch more often. The integration will run automated tests and verify that the service is up and running. If the tests find no bugs, the system is deployed. Advantages of this approach:

- Ease of tracking changes and conflicts;
- Quick detection of errors when running automated tests;
- Easy and straightforward verification of the correctness of changes [4].

Small updates should be released instead of one large update. Small updates will make it easier to test and analyze the code. The most important thing is to keep the system running continuously.

Each service should usually keep a logbook. But when services are deployed, services will lose their logs. To cope with this problem, centralized logging is necessary. With this approach, each service sends logs in a standard format to a single system. In order to recognize, which service a particular log belongs to, it is necessary to use correlation identifiers. It should be checked that the service stores this identifier in the logs. If you specify the identifier when searching, we will be able to see the path of the request by service.

Services do not need to be placed on a separate server, it is possible on one server, provided that each of them has its own database. But in case of a server failure, services can fail or one of the services will consume a lot of resources, slowing down the rest.

Frequently occurring problems and ways to solve them.

Sometimes it happens that one of the services fails more often and faster than the others. This is usually caused by an overload of the service. Stable operation of the services is achieved by setting limits. This should be done on services that are not able to scale automatically and quickly [5].

Services handle a lot of requests, but it also happens that for one service, a large number of requests is submitted. And this leads to a flood of requests to the following services, that is passed down the chain. The problem of passing requests up the chain is solved by using connection pools. They limit the number of requests sent to the next service. This approach will protect the whole system from failure.

In most cases, one user request causes more than one service to kick in. If the request causes an error, then the task of fixing the error becomes more difficult. In order to simplify the task, a correlation identifier should be used. This identifier is added to the request and the other services see it. Thanks to this identifier and the event log it will be easy to see the path of the request.

You should use centralized monitoring to assess the scope and source of the problem. It allows you to get an overview of the situation and know if a failure has occurred in only one service or in all services.

Conclusion

Although microservice architecture eliminates most of the disadvantages of monolithic applications and has advantages, it is still not appropriate to use it everywhere. In some cases, other architectures will be more appropriate.

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SUSTAINABLE MANUFACTURING AND RECYCLING OF CLOTHES

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Abstract. This article discusses the sustainable methods of production of clothes by the world-famous clothing brand H&M. As a result, the main environmental initiatives of the H&M company were formulated, which can become prerequisites for the development of the rational consumption of natural resources in the textile industry as a whole.

Keywords: sustainable manufacturing, recycling, recyclables, ecology, textile manufacturing processes.

ЭКОЛОГИЧНЫЕ СПОСОБЫ ПРОИЗВОДСТВА И ПЕРЕРАБОТКИ ОДЕЖДЫ

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Аннотация. В статье рассматриваются экологичные способы производства на примере всемирно известного бренда одежды H&M. В результате анализа сформулированы основные экологические инициативы работы компании H&M, которые могут стать предпосылкой для развития рационального потребления природных ресурсов во всей текстильной промышленности в целом.

Ключевые слова: экологически рациональное производство, переработка, утилизация, вторсырье, экология, процессы текстильного производства.

In today's world, the importance of environmentally friendly production of various goods is becoming more and more acute every year. The problem of ecology has become global, the number of populations is growing every year,

and the stock of resources is depleting. The fashion industry accounts for 10 % of global greenhouse gas emissions, including 4 % of global CO₂ emissions, and this has the prospect of increasing to 25 % of global GHG emissions by 2050 [1]. Compared to sectors generally considered highly polluting, such as aviation and shipping, the fashion industry emits much more GHGs (10 % versus 4.4 % for aviation and shipping). Therefore, many global brands are trying to make their production environmentally friendly. Ways to increase eco-friendly production can be considered on the example of a large Swedish clothing brand, H&M.

In meeting the demand for greener production, the company is turning to recycling opportunities. H&M declares that by a certain time it will come to a fully circular and renewable model of activity.

The main H&M environmental initiatives are presented below:

- *Power Savings.* Today the company gets 18 % of its energy from alternative sources – windmills and solar panels. In 2013, solar panels generated enough energy to run 145 production buildings for a year. In the future, H&M plans to switch completely to alternative energy sources.

- *The use of recycled plastic.* The plastic accessories and shopping bags hanging at the entrance of the store are made from recycled plastic. It recycles bottles from household chemicals, plastic bags, and PET. This recycling saves oil and energy. H&M gets its jersey fabric by recycling polyamide from protective sheeting waste and old fishing nets.

- *Garment Collecting program.* Of the thousands of tons of textiles that are thrown into landfills every year, 95 % can be recycled into new garments. In 2013, H&M invited people to bring their old clothes to the nearest H&M store. Under the slogan “Long live fashion!” the Garment Collecting program quickly gained popularity, including in Russia.

Items from H&M stores are sent to the German company I:CO for recycling and sorting. The brought items are divided into three categories. The Rewear category goes to secondhand shops (40-60 % of all items). The Reuse category includes items that are not suitable for wear, they are used as cleaning rags (5-10 %). And the third category of textiles, Recycle, goes for recycling (30 %).

- *The use of recycled materials.* The company sews Conscious and Conscious Exclusive collections from items collected through the Garment Collecting program. At the moment H&M can use no more than 20 % of secondary fibers in the production of recycled cotton, linen and wool without losing quality. The technologists are sure that in a couple of years this figure will reach 100 %. Denim is also recyclable. H&M presented the Conscious Denim collection, which uses recycled denim. The technologists investigated

the environmental impact of the way jeans are made. The main goal is to reduce water and energy consumption as much as possible.

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– *Organic and recycled cotton.* Most farmers use pesticides when growing cotton. H&M uses organic cotton grown without chemical pesticides and without GMOs to make its clothes. But using organic cotton does not solve the problem of water consumption. To grow enough cotton to sew one pair of jeans, it takes 8.500 liters. The company supports farmers who grow organic cotton, and has even developed a technology for growing cotton with the least use of resources, together with the Better Cotton Initiative. More than 200.000 farmers are supported by the organization and grow organic cotton.

Therefore, the company focuses on the production of cotton fabrics from surrendered clothing and production residues. Using recycled cotton saves natural resources.

– *Lyocell instead of cotton.* The company already uses lyocell, a cellulose-based textile fiber, as a material. The properties of the fabric are similar to cotton. Bamboo and eucalyptus are used to produce lyocell for H&M. These species of trees grow quickly and do not require frequent watering, unlike the cotton crop. This season they used Bloom Foam, a resilient algae foam, Pinatex, a natural leather substitute made of cellulose fibers from pineapple leaves, Orange Fiber material, which is created from residues of citrus juice production, and citrus peels. Cellulose is extracted from the waste, and is then processed and spun into useable yarn for both knitted and woven fabric production. The company also claims that additional benefits can be gained from the product. It has been well documented that extracts of citrus fruit peel can contain compounds such as essential oils, natural colors, and phenols, which all have associated biological activities such as antioxidant, antimicrobial and anti-inflammatory effects [2]. Orange Fiber is particularly marketing the additional skin moisturizing benefits of their textile, claiming this is due to embedded essential oils [3].

However, despite all the measures taken by the company, the implementation of these initiatives raises many questions. In Russia, the H&M

scandal received a lot of publicity. Worn items, which customers turned in for recycling in stores in Moscow, St. Petersburg and Yekaterinburg, were sent to a warehouse from where they were sold via the Internet. Old clothes are purchased mainly by owners of second-hand shops. The clothes are not sorted and what cannot be resold is sent to a landfill, which is fundamentally inconsistent with the textile recycling initiatives announced earlier.

Also, not in favor of the company is the fact that according to experts' calculations they will not be able to work off even a tenth of all the clothes collected for recycling. With a rather limited number of recycling technologies and recycling plants H&M will take about 12 years to use only 1 ton of recycled material. While the company's official website states that a total of more than 12 tons of clothing has been collected so far.

In 2017, it was reported that the brand H&M, which has been promoting eco-friendly fashion and conscious consumption for years, burned 28 tons of new clothes that failed to sell in Sweden and Denmark.

To summarize, the environmental policy of H&M raises many questions, but the desire to make the brand more environmentally friendly is a good prerequisite for the trend of rational consumption of natural resources not only within this brand, but also the entire textile industry as a whole. Fashion industry has huge impacts on global environment [4; 5; 6]. Therefore, changes in this sphere will change the environmental situation all over the world.

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OVERVIEW AND ANALYSIS OF MODERN TYPES OF ENGINES

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Abstract. This article briefly shows the history of the development of various types of engines. The best options for using modern engines in day-to-day life are considered and the most profitable option is analyzed: which is better – petrol, diesel or electric engine?

Keywords: engines, petrol, automobile, diesel, vehicle, transport, electric vehicles, efficiency.

ОБЗОР И АНАЛИЗ СОВРЕМЕННЫХ ВИДОВ ДВИГАТЕЛЕЙ

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Аннотация. В данной статье кратко представлена история создания различных типов двигателей. Рассмотрены оптимальные варианты использования современных двигателей (бензиновый, дизельный, электрический) в повседневной жизни и проанализирован наиболее выгодный из них.

Ключевые слова: двигатели, бензин, автомобиль, дизель, транспортное средство, транспорт, электромобили, экономичность.

In the modern world, there is a huge variety of automobile engines of various types and designs. The most popular are internal combustion engines. The project of the first engine of this sort belongs to the famous inventor of the clock escapement system Christian Huygens and was proposed back in the 17th century. It is interesting that gunpowder was initially proposed to be used as fuel, and the idea itself was prompted by an artillery gun. All attempts by Denis Papin to build a machine founded on this principle were unsuccessful. The first reliable internal combustion engine was designed in 1860 by the French engineer Etienne Lenoir. The Lenoir engine ran on gas fuel. After 16 years, German designer Nicholas Otto created a more advanced 4-stroke gas engine.

Many engineers and mechanics were involved in improving the internal combustion engine. So, in 1883, the German engineer Karl Benz manufactured the 2-stroke internal combustion engine that he later used. In 1897, his

compatriot and also an engineer, Rudolf Diesel, proposed an internal combustion engine with ignition of a flammable fuel in the cylinder by compressing it in a very short amount of time, this type of engine was later called the diesel engine.

In 1834, the Russian scientist Boris Semyonovich Jacobi created the first DC electric motor suitable for practical use. In 1888, the Serbian student and future great inventor Nikola Tesla expressed the principle of building two-phase AC motors, and a year later, Russian engineer Mikhail Osipovich Dolivo-Dobrovolsky created the world's first 3-phase asynchronous electric motor, which became the most common electric machine.

Currently, there are a large number of disputes: which engine is more profitable to use in cars? This question is asked by both scientists around the world and ordinary people who want to minimize their expenses for their personal transportation vehicles. So, which are better: diesel, gasoline or electric vehicles? Let's examine everything in order.

A diesel engine is a reciprocating internal combustion engine in which the fuel is ignited in the cylinders when it interacts with air heated as a result of compression. This type of motor is named after its creator: the German engineer Rudolf Diesel, who received a patent for it in 1892. The advantages of using this type of engine include [1]:

- Higher torque and better efficiency than petrol and natural gas. Due to this: the speed, dynamics and fuel consumption of a car when under load is better than that of a similar gasoline internal combustion engine, but worse than an electric engine.
- Excessive fuel consumption is lowered and the acceleration of a loaded car is higher than that of a petrol car.
- Better for frequent driving on hills, mountains, serpentines and off-road environments.
- Fuel consumption from the car's included air conditioner is lower than that of a petrol or natural gas car.
- Diesel engines are more reliable when driving frequently with load.
- No spark plugs required. But for winter glow plugs are required.
- With frequent driving on highways, a diesel engine can be serviced less often than a gasoline one.

However, there also some disadvantages in the way the diesel engine performs in some situations [1]:

- Diesel is beneficial only if you drive more than 20 thousand kilometers in a year. (Exception – regular driving around the city).
- Diesel is not recommended to be used regularly in a city with traffic jams, if the average car speed per quarter is less than 25 km / h, then the EGR becomes contaminated and the catalyst cannot burn through normally which, in turn increases the chances of a breakdown.
- In winter, winter diesel fuel is needed. It is 2-3 % more expensive than the summer one. Less efficient than diesel made for higher temperatures,

consumption values increase: lower density and lower cetane number, which shows the ignitability of diesel.

- Higher risk that the fuel will freeze in cold weather.
- In winter, diesel engines heat up more slowly, so it is necessary to install a fuel heater.
- Maintenance of diesel fuel engines is more expensive than their petrol counterparts (parts are more expensive, more engine oil, etc.).
- The price of modern Euro-5 diesel fuel has approached AI-95 petrol and continues to grow, which increases the payback period of a car.
- Fuel systems of old Euro-3 diesel engines and below wear out quickly from lack of lubrication and sulfur in Euro-5 fuel.
- Euro-4 diesel engines and below usually emit strong vibrations and sound.
- Diesel fuel has a pronounced odor, which requires you to be careful when refueling and use gloves.
- Some diesel engines require urea to be filled with diesel to comply with Euro regulations. Which increase costs and prevents the full use of the diesel transportation vehicle in the winter, due to te freezing point of urea peaking at -10°C .
- If you are planning to travel around Europe, please note that since 2019, many cities in Europe prohibit the entry of diesel cars Euro-4 and below.

Petrol or gasoline engines are a class of internal combustion engines in which a pre-compressed air-fuel mixture is ignited by an electric spark in the cylinders. Power control in this type of engine is usually carried out by regulating the air flow by means of a throttle valve. The advantages of this type of engine can be noted:

- The wide revolution range and horsepower advantage provide better overtaking dynamics than a diesel. But only if we are talking about an unloaded car.
 - No problems with freezing fuel in the winter.
 - More environmentally friendly than diesel due to a lower release of carbon micro particles into the Earth's atmosphere.
 - More options for car tuning.
- But, of course, there is a nuance that petrol engines exhibit:
- Modern gasoline cars are more likely to suffer from oil burnout.

Given all the features of gasoline and diesel engines, we can conclude that both have pluses and minuses. In short, gasoline is more suitable for passenger cars, diesel is often chosen for SUVs and commercial vehicles [2].

An electric motor is a special machine (it is also called an electromechanical converter), with the help of which electricity is converted into mechanical motion. A side effect of this conversion is the generation of heat. At the same time, modern engines have a very high efficiency, which reaches 98 %, as a result of which their use is more economical than internal combustion engines. This relatively new variety of engine has a huge number of advantages over others:

- Maximum torque is available almost immediately. From this, the car accelerates more smoothly and dynamically.
- In the case of a full load, the car retains its dynamism and speed more efficiently than a diesel engine.
- Most electric cars do not have a gearbox: the car becomes more reliable and comfortable.
- The most environmentally friendly urban transport: no exhaust gases, no engine oil.
- Full wheel drive vehicles have separate independent engines. In the event of a breakdown, the car will be able to drive with one engine.
- Many people think that batteries will fail quickly, especially in northern countries. However, the real experience of the northern European neighbors shows that the most modern electric vehicles with new generations of batteries lose, on average, not more than 3 years of operation.
- More than 15 % capacity. Jaguar I-PACE for cars sold in Russia gives a guarantee of proper battery operation for 8 years (or 160 thousand km) and the charge capacity will not fall below 70 %.
- Altitude does not affect consumption. Discharged air does not cause overruns.

Nuances and disadvantages:

- Formally, modern batteries need to be changed after 10 years or 300 thousand kilometers, when the batteries are old enough and their capacity drops below 50 %. Many claim that the replacement cost will be very expensive. But if we compare it with the costs of servicing a car with an internal combustion engine for the same period, then it turns out to be equal, or even cheaper.
- Poorly developed infrastructure in Russian cities outside Moscow or St. Petersburg.
- A lot of energy is spent on heating or cooling the cabin.
- Long refueling.
- In the production of batteries for electric vehicles, much more harm is done to the environment than in the production of any conventional engine and a couple of years of its operation. In the future, with proper disposal of obsolete batteries, the situation will improve.

Summarizing all of the above, we can calculate that a vehicle using an electric motor is several times more efficient than a similar vehicle with an internal combustion engine.

What is still more profitable in daily use? Different types of engines are suitable for different regions of our country [3]. For example, for the northern regions of Russia, where the temperature often drops to -30 °C and winter lasts almost half a year, gasoline is the best option. Facts against the rest:

Diesel – winter diesel is expensive, less efficient (cetane and density are lower), there is a risk that it will freeze, the engine and car interior are not heated well. Additional heaters often do not really help and only spend extra fuel.

Electric – if you drive from a warm garage to work, where a warm parking lot with an outlet is also waiting for the car, then the option is good. In

northern Europe, modern electric vehicles are already very popular, they can easily withstand severe frosts and have self-heating batteries. But in the north of Russia there is no infrastructure where you can quickly charge a car. Conditionally, Electric vehicles have a chance of development in the north, after 2030, when new generations of batteries appear and the infrastructure begins to develop actively [3].

What about moderate climatic regions like Moscow and St. Petersburg? Winter is no more than 3 months and frosts at -25 °C are rare. Most of the major cities fall into these regions: Moscow, St. Petersburg, Nizhny Novgorod, etc. Moderate winter allows the use of any type of fuel [3]. If the mileage is less than 15 thousand kilometers per year, then it makes no sense to overpay for the purchase of a diesel or gas car. However, an exception may be regular driving in a city with traffic jams. In the city, 7.000 kilometers of idling in traffic jams is equivalent to 15.000 kilometers on the highway, in which case you can consider a diesel car, fuel consumption will be much more economical in a traffic jam.

What is better for the southern region? Winter is mild, short and last from 1 to 2 months. But summer is long and has intense heat. Gas and diesel fuel is better suited for the southern regions. But if you drive less than 15.000 kilometers a year, then overpaying for a diesel engine is not profitable [3].

Gasoline, diesel, electric car, which is more reliable?

Conditional reliability rating [3]:

1. Electric vehicles – fewer mechanisms that can break. Replacing batteries comes at the same time when you have to overhaul a regular car;

2. Diesel – subject to the use of high-quality diesel fuel. Modern diesel cars are capable of driving 250 thousand km. without serious breakdowns, but not in a city with traffic jams;

3. Gasoline – the average mileage of a modern car before a serious comprehensive repair is 170 thousand km. or every 5 years.

If we consider options for Russia, where the winter is quite long and cold:

1. Gasoline

2. Electric cars – they occupy the second line, but in Russia the infrastructure of charging stations and services that can serve them is not well developed.

3. Diesel. The main drawback is the risk of freezing even with Arctic diesel fuel. In addition, in winter, especially Arctic diesel fuel, the cetane number is low, which significantly reduces engine power.

As for the future, hybrid cars in many countries are subject to incentives as well as electric cars. Therefore, demand and production are stimulated. Hybrid vehicles are understood as vehicles capable of driving from 50 km on an electric motor, and the rest on a conventional engine. Such cars allow saving up to 40 % of fuel compared to conventional cars [4]. The leaders in the production of such cars are Japanese automakers, who have launched a mass launch of them since 2010.

It is likely that in 2030 the share of electric vehicles in the world will be approximately 40 %. The rest will use an internal combustion engine or hybrids [5].

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QUANTUM COMPUTING AND ITS PRACTICAL APPLICATIONS

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Abstract. This paper considers the scope of quantum computing, its prospects, principles of operation and most importantly the key challenges of retrieving the results of quantum computing and computing itself alongside with the ways to resolve them.

Keywords: quantum computer, qubits, decoherence, superposition, interference, entangling, cryptanalysis.

КВАНТОВЫЕ ВЫЧИСЛЕНИЯ И ИХ ПРИМЕНЕНИЕ НА ПРАКТИКЕ

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Аннотация. В данной статье рассматриваются возможности квантовых вычислений, их перспективы, принципы работы и, самое главное, ключевые проблемы получения результатов квантовых вычислений и самих вычислений, а также пути их решения.

Ключевые слова: квантовый компьютер, кубиты, суперпозиция, интерференция, запутанность, декогеренция, криптоанализ.

In 1980 Yuri Manin, a soviet scientist has proposed to implement an idea of quantum computing. However, the idea become matter of discussions later in 1981, when J. Feynman noticed the impossibility of effective simulation of quantum system evolution on a traditional computer and came up with an elementary model of quantum computer capable of simulating it [1].

The quantum computer essentially is a computing device. The main difference is its fundamentally different quantum mechanics principles and data handling [2; 3; 4]. Quantum computers shine when it comes to computing lots of possible outcome combinations.

Quantum computer doesn't operate bits in which value is always explicitly defined, but rather is defined at each specific moment in time. In quantum computing qubits are used instead [5]. With its help all of the computing is parallel and not sequential like it is in conventional computers.

To understand the processes behind quantum computing, first we need to define qubits. Qubit – is the basic unit of information in quantum computing. We can once again draw an analogy with bits in classic computers. Although just like bits, qubits can take values of 0 and 1, there is third state of uncertainty. Qubit is one of the simplest quantum systems.

This probability of the qubit collapsing to a certain state is determined by quantum interference. Quantum interference affects the state of the qubit, affecting the probability of obtaining a certain result when measured. This probabilistic nature is what makes quantum computing so powerful.

For instance, we can take two bits which are underlying ordinary calculations. Combining them we can get 4 different values: 00, 01, 10, 11. But we need to keep in mind that at a given point in time only one value can be accessed. But with 2 qubits in the state of superposition one can have any of the possible combination at any given time as shown in Figure 1. With 3 qubits you'll have 8 values simultaneously, with 4 you get 16 and so on.

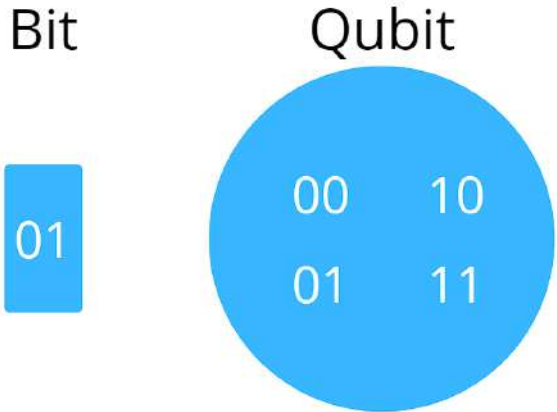


Figure 1. Bit and qubit in specific moment of time

Entanglement of several quantum systems is truly one of the fascinating phenomena in quantum mechanics. Entanglement is a quantum dependence of 2 or more quantum systems. Several entangled qubits form a global system where one subsystem cannot be described without taking into account all the others. Two systems are considered entangled if the state of the global system cannot be described as a linear combination of subsystems.

Entangled quantum systems can maintain such correlation even over long distance. Any change in one subsystem is going to affect the rest. Because of this interdependency we can get information from one qubit by measuring another. This property is extremely useful in quantum computing.

It's important to understand not every correlation between the measurements of two qubits means that the two qubits are entangled. Classical bits can also be correlated. Two qubits are entangled when they present correlations that can't be reproduced by using classical bits. This difference between classical and quantum correlations is subtle, but it's essential for the speedup provided by quantum computers [6; 7; 8].

Quantum computers combine the capabilities of classical and quantum computers. Modern quantum computers are based on hybrid model that consists of both: classical computer managing the quantum one.

The development of quantum computing seems to be in the very beginning of its path. Quantum equipment and its maintenance is very expensive and the majority of systems are located in universities and research laboratories. Quantum computers use quantum systems based on atoms, ions, photons or electrons instead of silicon chips in classical ones. They use their quantum properties to represent bits that can have one of the states in a quantum superposition. But the technology is improving, and some universities and labs starting to grant access to some of the systems.

A quantum computer consists of three main parts: a device with qubits, a qubit measuring method, method for performing quantum operations on qubits (also known as quantum gates), and a classical computer for executing a program and sending instructions. The type of qubits chosen to create a quantum computer determines their implementation.

Qubits are made of a fragile quantum material which is extremely sensitive to any environmental changes. For example, superconducting qubits storage has to maintain a temperature slightly above absolute zero to ensure maximum coherence. In other cases, the storage can be a vacuum chamber, which minimizes vibrations and stabilizes qubits.

Quantum operations (quantum gates) can be performed using a variety of methods including microwaves, laser, and voltage, depending on the type of qubit.

A lot of challenges have to be overcome to ensure smooth and correct quantum computer operations. Maintaining efficiency and quality of computations are the main struggles due to several factors. An increase in the number of qubits not only leads to exponential performance gains (due to qubit entanglement) but also leads to an increase in the number of errors in calculations. We also need to keep in mind fragile nature of qubits. External influence trigger decoherence – a loss of quantum coherence. It happens because of some processes such as temperature changes, external noise or vibrations. Errors has to be found, caught and corrected.

The simplest quantum error correction method is to create entangled state of original qubit with auxiliary qubits, so the measurement of the latter will allow to find an error and correct it. You can see it in a Figure 2.

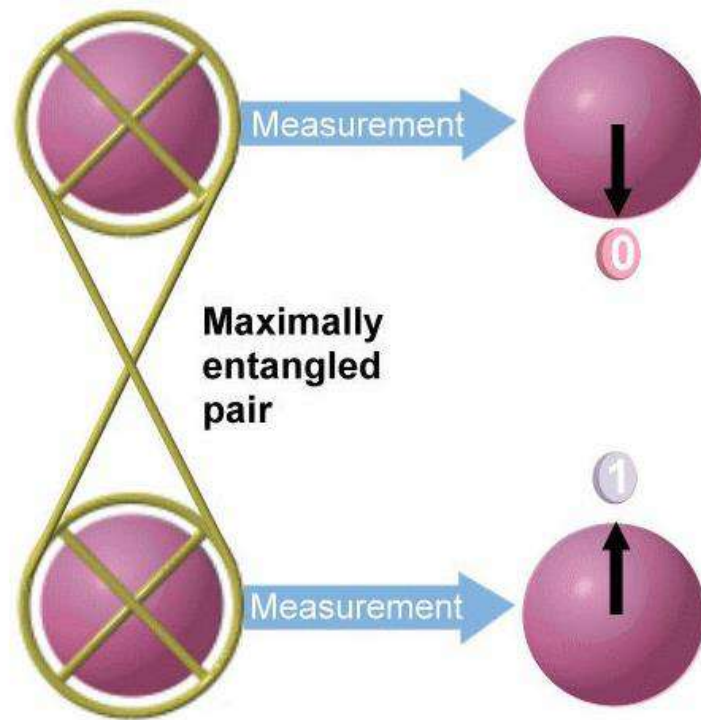


Figure 2. Two parallel entangled qubit subsystems

Both subsystems get confused and auxiliary ones control the operation of the logical subsystem. Periodically, the qubits of the auxiliary subsystem are measured, and if an error is detected, corrective pulses are sent to the subsystems. It is worth mentioning that operations with qubits are reversible. Although the initial state is random, all subsequent operations can be reversed and the original state can be found. But it works only if the final state has not been measured [9].

These restrictions make the idea of personal quantum computer a distant prospect. The concept of remote access to commercial developments seems more realistic.

Quantum computers can be divided into two subtypes: quantum simulators and universal quantum computers. Universal quantum computers are similar to classical general-purpose computers. Quantum simulators are specialized devices for understanding specific physical calculations.

Quantum computing can be applied in various fields of science and everyday life. For example, we can use it to simulate material interactions and its physical processes. Quantum computers can process it so much faster than classic supercomputers, but these calculations require further increase in performance. Current power is sufficient only for simulating individual simple molecules [10].

Quantum computing is quite useful in cryptanalysis. It's used for a massive iteration of the values of the encryption keys. Swiss company Terra Quantum AG managed to break a widely used symmetrical encryption algorithm AES. There is a Shor algorithm that was developed long before that. It's a prime factorization algorithm that is famous for hacking application. This operation is

nearly impossible on a classical computer when operating large numbers, but quantum computers handle it easily [11].

The possibility of speeding up optimization and machine learning problems are being explored by quantum computers. Thanks to special algorithms the 51-and 53-qubit systems that were developed at Harvard and Maryland in 2019 can also help here. They can be used for algorithm optimization that is important for training artificial neural networks due to concurrency of quantum computing. At the same time, in many problems, finding a good approximate solution relatively quickly can be more important than, exact solution. It can be beneficial for a number of logistics and transport problems. Along with other optimization problems quantum machine learning remains one of the most promising and interesting applications of quantum computing.

In the field of quantum computing Russia is a competitive country. We are developing several projects of quantum computers based on different materials. Within the framework of the national program “Digital Economy of the Russian Federation”, a roadmap for the development of quantum technologies is being developed.

This will allow our country not only to contribute to the global research of quantum computers, but also to advance itself on this path, providing very useful experience and wide opportunities for many scientists. Scientists from the P. N. Lebedev Physical Institute of the Russian Academy of Sciences have presented a prototype of an ion-based quantum computer lately. The choice of an ion system is due to the fact that ions take a leading position among known systems, and what is important is the presence of extensive experience and research on ions [12].

Despite the well-known lag from the leading companies, the task is to catch up with the current leaders. Due to the fact that a development plan has already been drawn up, and sufficient funding has been provided in this area, the task set is realistic and pretty feasible.

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MAIN TYPES OF AUTOMATED ELECTRIC LIGHT SENSORS AND THEIR CONTROL SYSTEM

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Abstract. This paper contains the most relevant information about lighting sensors, its types, the control system and installation schemes.

Keywords: photoresistor, photorelay, arduin, photodiode, phototransistor.

ОСНОВНЫЕ ВИДЫ АВТОМАТИЗИРОВАННЫХ ЭЛЕКТРИЧЕСКИХ ДАТЧИКОВ ОСВЕЩЕНИЯ И ИХ СИСТЕМА УПРАВЛЕНИЯ

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Аннотация. В данной работе содержатся наиболее актуальные сведения о датчиках освещения, об их видах, о системе управления и схемах установки.

Ключевые слова: фоторезистор, фотореле, ардуин, фотодиод, фототранзистор.

Nowadays, light sensors are most commonly used to turn on exterior lighting. They allow you to save on electricity consumption, as well as automate the switching on of lighting when it is dark.

There are many names of photosensors. But the principle of operation and the structure of the sensors remain the same: at nightfall the lamp turns on and at dawn it turns off.

How it works? The device contains phototransistors, photodiodes and photothyristors. The light sensitive elements are coupled to the operation of the relays. When the natural light changes and a certain level of darkness is reached,

the detector activates, the relay contacts close, the light turns on, and the opposite reaction occurs at dawn [1].

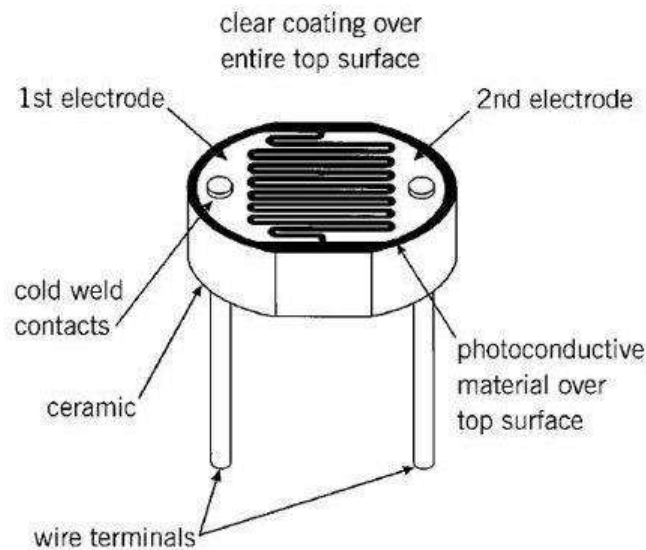


Figure 1. Type of photoresistor

According to the principle of operation, the photocells are divided into three groups:

- programmed triggering;
- equipped with a sensor triggering on motion;
- with timer.

Let's look at the principle of operation. All light sensor operations would be inconceivable without the photocell. Its electrical contacts close the circuit when the light falls to a preset level. The contacts open as soon as the light flux rises to another pre-set value. The light relay is quite simple. The housing is used to house the key elements. Holes for fasteners or other devices are also prepared in it. A photocell takes care of assessing the light. Under the influence of light, an electric current is generated in it. According to the characteristics of this current, the automation can estimate how strong the flow of light is coming from the outside [2].

How the photoresistor is connected. If you use a photoresistor, in the connection diagram the sensor is implemented as a voltage divider. One arm changes from the light level, the second arm supplies voltage to the analog input. In the controller chip this voltage is converted into digital data via ADC. Since the resistance of the sensor decreases when light hits it, the value of the voltage incident on it will also decrease [3].

Depending on which arm of the divider you put the photoresistor in, the analog input will have either an increased or decreased voltage. If one leg of the photoresistor is connected to ground, then the maximum voltage will correspond

to darkness (the resistance of the photoresistor is maximum, almost all the voltage falls on it), and the minimum to good light (resistance is close to zero, voltage is minimum) [4]. If you connect the arm of the photoresistor to the power supply, the behavior is opposite. The photoresistor has no polarity, you can connect it either way, you can solder it to the board, wire it with a mounting plate or use ordinary clips (alligator clips) for connection. The power supply in the circuit is the arduino itself. The photoresistor is connected with one leg to ground, the other is connected to the board's ADC. Connect a 10 kOhm resistor to the same leg [5].

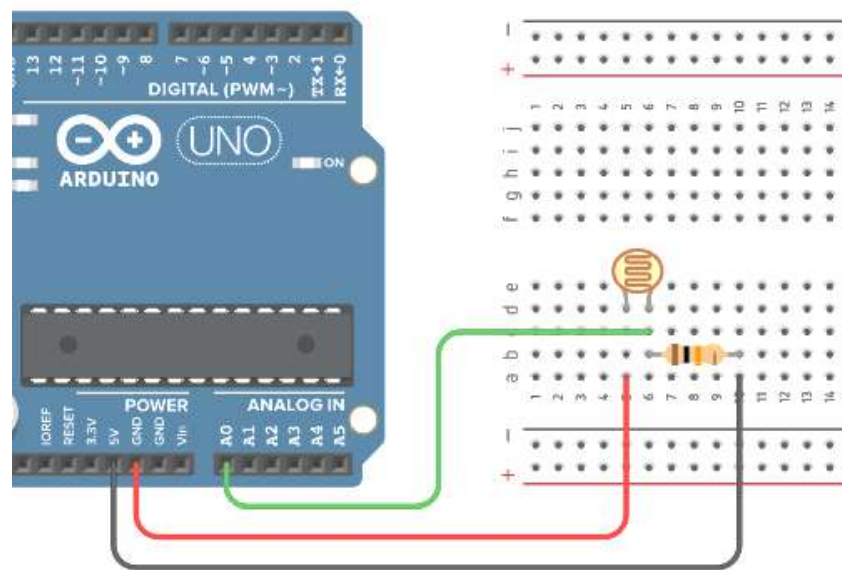


Figure 2. Connecting the photoresistor to the Arduino

The main advantage of using a light sensor is that it helps to save electricity. And the adjustment is done automatically. There is no need to make a careful schedule or monitor a slight change in the situation [6].

Projects using a light sensor based on a photoresistor are quite simple and effective. You can implement many interesting projects, and the cost of the equipment will not be high. The photoresistor is connected by a voltage divider circuit with an additional resistor.

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THE ROLE OF CONSUMER BEHAVIOR IN THE RUSSIAN ECONOMY DURING THE PANDEMIC AND SANCTIONS

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Abstract. This article discusses the main factors in changing the consumer and financial behavior of people in a pandemic. In the course of the study, the features of the development of sectors of the economy that were most affected by the conditions of the pandemic were considered. The purpose of the article is to research the statistics of income and expenditures of the population, considering the transformation of consumer behavior, and conduct a comparative analysis with data from the previous years. Analyzed the activities of public institutions, namely financial organizations, governments, banks. The measures of consumer support on their part in the conditions of a pandemic are given. The influence of state institutions on the quality of people's lives, as well as the effectiveness of their measures and activities, has been studied.

Keywords: consumer behaviour, demand, sanctions, pricing, pandemic, online-shopping, digitalization.

РОЛЬ ПОТРЕБИТЕЛЬСКОГО ПОВЕДЕНИЯ В РОССИЙСКОЙ ЭКОНОМИКЕ В ПЕРИОД ПАНДЕМИИ И САНКЦИЙ

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Аннотация. В данной статье рассматриваются основные факторы изменения потребительского и финансового поведения людей в условиях пандемии. В ходе исследования были рассмотрены особенности развития секторов экономики, которые в наибольшей степени пострадали от условий пандемии. Целью статьи является исследование доходов и расходов населения с учетом изменения потребительского поведения и проведение сравнительного анализа с данными за предыдущие годы. Проанализирована деятельность государственных учреждений, а именно

финансовых организаций, правительств, банков. Приведены меры поддержки потребителей с их стороны в условиях пандемии. Было изучено влияние государственных организаций на качество жизни людей, а также на эффективность их деятельности и принятых мер.

Ключевые слова: потребительское поведение, спрос, санкции, ценообразование, пандемия, интернет-магазины, цифровизация.

The revision of priorities, values, and lifestyle of consumers in the conditions of a pandemic is identified as the main trends in consumer and financial behavior. Namely, increased attention to taking care of your health, involvement in online marketing, especially delivery services, reorientation of many areas of life into digitalization. The indicated trends in consumer and financial behavior require a revision of the programs and tools of market participants.

This study is still relevant to this day, since the pandemic period has not yet ended. Recommendations are also given to government agencies, marketing market companies and consumers of actions to improve the quality of life due to the consequences of the pandemic.

The year 2020 was characterized by special changes in all spheres of life. The pandemic has led to a transformation of the size of incomes and expenditures of the population, the structure of the labor market and marketing, economic indicators of enterprises in various sectors of the economy and types of activities. In the process of this transformation, various habits of the population, motives and needs for making purchases of those categories of goods that play a special role in the conditions of the pandemic have been formed.

The topic is particularly relevant at the present time. The coronavirus epidemic has a significant impact on all spheres of society, including the country's economy. Consumer and financial behavior are the foundation of economic well-being. Consumer demand plays an important role in the financial well-being of the country, therefore it is important to maintain the security and awareness of the population in these conditions. The needs and motives of consumers are constantly changing and they determine the demand for goods and services. Behavioral economics is engaged in the study of consumer behavior – it is an interdisciplinary science that includes economics, psychology, ethics, philosophy, sociology and a number of other sciences [1].

Consumer behavior plays a major role in the formation of economic relationships. That is why many countries analyze this aspect by conducting various social surveys to identify the behavioral attitudes of the population. Currently, consumer behavior is defined as a field of knowledge that studies the

processes of consumer decision-making, and the factors that influence these decisions.

Income level, consumer preferences, prices of goods and services also have a huge impact on consumer behavior. Other factors, such as psychological, socio-cultural and personal, also influence consumer behavior. Social factors reflect the influence of others, including family, friends, on the decisions and actions of consumers. Cultural factors show the stereotypes and values of society as a whole and the consumer separately. Psychological factors are the internal attitudes, beliefs, principles of the individual, his motives of behavior. Personal factors are expressed through age, gender, gender identity, self-perception. The influence of advertising and mass media on consumers is also an important factor [2].

As for the financial behavior of citizens, this is one of the most important indicators of the activity of the population in the field of finance, indicators that allow us to understand how citizens are ready to dispose of their own funds. Financial behavior is a kind of economic behavior that includes a huge variety of actions, such as: obtaining financial resources at the expense of a loan, paying taxes and other mandatory payments, consuming resources in the field of finance through the acquisition of property.

The change in the model of financial behavior of the population during the crisis is manifested in the results of the analysis of the data of the Bank of Russia on the structure of liabilities and capital of the banking sector. Liabilities and capital of the banking sector for the period from 01.01.2020 to 01.01.2021 increased by 16.9 %, while the volume of deposits of individuals for the same period decreased by 7.3 % (by 0.8 % for the period from 01.02.2020 to 01.02.2021), respectively, there was a decrease in the proportion of deposits of the population in the capital of banks [3].

Speaking about the absolute dynamics of deposits, it is worth noting that out of the 156 months covered by the analysis, only 32 months recorded a net outflow of funds from deposits, while the number of such in 2016 and 2020 was the same, but the total net outflow in 2016 amounted to 658.7 billion rubles, whereas in 2020 – 2284.6 billion rubles. The largest monthly outflow in the period under review was recorded in April 2020 – 591.6 billion rubles, and the smallest - in November 2019 – 2.1 billion rubles.

The traditional savings model has also changed, as evidenced by the change in the term structure of ruble deposits of the population in 2020. Thus, since the beginning of the year, the volume of deposits placed for a period of 91 to 180 days has decreased by 29.8 %, and deposits for a period of 1 to 3 years – by 10.1 %, as a result of which the share of the latter in the total volume of deposits decreased from 32.6 % at the beginning of the year to 28.0 % at the end of the year.

One of the sectors of the economy that has changed a lot during the pandemic is the retail sector. Thus, since April 2020, about 20 % of the retail and service enterprises of small businesses operating in February-March have closed in Russia, and by the end of April, the turnover of small and medium-sized businesses fell by 54 % compared to April 2019. The tourism industry, fitness centers, bookstores and catering enterprises were particularly badly affected.

However, online companies have improved their performance due to the introduction of restrictive measures. Thus, the leader of the Russian online trading market, Wildberries, increased its turnover by 104 %, to 285.6 billion rubles, according to the results of nine months, Ozon also increased its turnover by 2.4 times (to 121.6 billion rubles). Unprecedented sanctions that Russia is subject to in 2022, actually put the country in conditions of an economic blockade. Naturally, the Russian securities market was the first to react to the sanctions. According to experts, in 2022 the real incomes of the population will fall by 1.5-2 times.

Due to the fact that the majority of foreign companies decided to impose sanctions against the Russian Federation, and also reported a complete cessation or suspension of activities on the Russian market, the supply of a number of goods was stopped – temporarily or permanently. Of course, some of the goods will be replaced by domestic products or by imports from countries that have not imposed sanctions against the Russian Federation. But, unfortunately, even these actions do not exclude a shortage of goods, for example, office paper, herring, Swiss chocolate, coffee, bananas, olive oil, imported alcohol.

Changes are expected in the financial sector; consultants, marketers, marketers; office workers; a wide class of people who earned money using social networks. A small percentage of social network users will be assigned to the PN, that is, the number of potential customers for everyone who has built their business around social networks will drop sharply.

The banking sector has already felt Western sanctions. In addition to disconnecting sanctioned banks from the SWIFT international system, on February 28, 2022, the Central Bank raised the key rate to 20 % per annum. This has led to an increase in the cost of credit products for ordinary people. Recall that before that, the rate of the Central Bank of the Russian Federation was 9.5 % per annum.

Deposit rates have also started to rise. For example, in Sberbank you can put money at 21 %, in VTB – at 22.93 %, in Alfa-Bank – at 20 % per annum. The increased rate is valid for the first three months, and then it decreases to 7-10 % per year, so it will be possible to earn a little on deposits. Prices for products such as sugar, buckwheat, vegetable oil, butter, cheese, tomatoes, chicken, eggs, rice have also increased significantly.

At the moment, the economic effect of the imposed sanctions is just beginning to manifest itself. In the near future, serious interruptions in the supply of food and non-food products should not yet occur. But stores are already raising prices for almost all products, as they expect a stoppage or disruption of supplies.

Food imports to Russia were not sanctioned. Therefore, a shortage of foreign products may temporarily arise only due to the complication of delivery procedures. Domestic products also should not run out. Despite this, the authorities are seriously considering the issue of state regulation of prices for socially significant products. It is planned that this will be a serious measure to support Russians in a crisis. That's just the state regulation of prices very often causes a shortage, since it is unprofitable for manufacturers to produce products with minimal income or at a loss to themselves [4].

In relation to non-food products, a shortage may indeed occur. Not in all areas, domestic companies can produce products that are similar in characteristics to foreign analogues. A shortage may arise in electronic equipment, computers and gadgets, since almost all world brands have announced their withdrawal from the Russian market; in foreign-made cars, since factories in Russia have suspended work; in fabrics and accessories, since these products are made abroad or from foreign materials. As for the current sanctions situation, despite the severity of measures against banks and the Central Bank, Russia still has opportunities to strengthen the ruble.

Thus, summing up, we can conclude that the coronavirus pandemic has had a significant impact on consumer and financial behavior around the world, and in particular in the Russian Federation, by increasing the activity of citizens in the field of online shopping and reducing it offline, demand in some areas (food, medicines delivery ready-made food) has risen significantly, while the demand in the field of travel, visits to cinemas has significantly decreased.

As for the current situation, it is worth noting that not only ordinary buyers, but also catering establishments will suffer from the sanctions imposed. In the current situation, many high-end establishments will either have to fundamentally revise the concept, or close down. Those who remain will have to look for new suppliers, recycle the menu and, most likely, engage in independent production.

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THE POSSIBILITY OF REPLACING PEOPLE WITH ARTIFICIAL INTELLIGENCE

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Abstract. This paper discusses features of artificial intelligence (AI) and possibility of replacing people with AI. As a result of the analysis, assumption about influence of AI development on unemployment in near future is set.

Keywords: artificial intelligence, human, robots, jobs.

ВОЗМОЖНОСТЬ ЗАМЕНЫ ЛЮДЕЙ ИСКУССТВЕННЫМ ИНТЕЛЛЕКТОМ

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Аннотация. В данной статье обсуждаются возможности искусственного интеллекта (ИИ) и замены людей ИИ. В результате анализа выдвинуто предположение о влиянии развития ИИ на безработицу в ближайшем будущем.

Ключевые слова: искусственный интеллект, человек, роботы, рабочие места.

Recently, there have been many reports about artificial intelligence, which in the near future will be able to replace human professions where human qualities are needed.

AI has replaced humans in many areas, for example:

-Factory workers

In 2015, a Chinese company opened the first fully robotic factory. Previously, such production facilities would have required 650 people, today there are only 60 of them. There are only pluses: productivity increased by 162.5 %, and the number of defects decreased by 5 times [1].

-Drivers

For many years, metro trains without a driver have been running in all world capitals. Tesla can overcome huge distances without human intervention. By 2030, up to 80 % of all cars on the roads are predicted to drive automatically.

-Translators

Google Translate developers have connected neural networks to the system to analyze the context. Today many Internet translators can translate large texts just as well people do [2].

But why is AI dangerous and should we be afraid of it? Even some of the creators of AI are afraid of their own invention. Indeed, the faster artificial intelligence technologies develop, the more people fear that robots will leave people without work and completely take their place. So it was with the steam engine in the era of the industrial revolution, which practically destroyed many professions, so it was with electronic computers that replaced humans in tasks based on mathematical calculations.

In 30 years, robots will be able to do almost everything that people can do. This will lead to the fact that more than 50 % of the inhabitants of the Earth will become unemployed, fears Moshe Vardy, a well-known professor of computational engineering. We are approaching the time when machines will surpass humans in almost every field.

For a long time, technological limitations stood in the way of automation – machines could not recognize speech, could not speak, could not understand the meaning of statements well enough. According to experts, thanks to recent advances in the field of AI, many of these restrictions have actually been overcome. Moreover, many professions themselves have undergone a transformation that has made them more suitable for automation [3].

But can we ever fully trust AI? When famous people, like Elon Musk, talk about risks of fast development of AI, they usually compare pros and cons of artificial intelligence.

Let's look at some of pros and cons of AI.

Pros:

1) Reduction in Human Error

Computers, however, do not make these mistakes if they are programmed properly. With AI, the decisions are taken from the previously gathered information applying a certain set of algorithms.

Example: In Weather Forecasting using AI they have reduced most of the human error.

2) Faster Decisions

Using AI we can make machines take decisions faster than a human. While taking a decision human will analyze many factors both emotionally and practically but AI delivers the results in a faster way.

Example: Chess games in Windows. It is nearly impossible to beat computer in the hard mode because of the AI behind that game. It will take the best possible step in a very short time according to the algorithms used behind it.

3) *AI doesn't get tired*

Artificial Intelligence and the science of robotics is used in mining and other fuel exploration processes. These complex machines help to explore the ocean floor and overcome human limitations.

Due to the programming of the robots, they can perform a more laborious task with extra hard work and with greater responsibility.

4) *AI does tasks that are too dangerous for us*

AI software running in robots can do tasks that humans find dangerous.

Today, AI-powered robots can assist or takeover perilous manufacturing, surveillance, and maintenance work, so that human workers don't have to risk life.

Cons:

1) *AI can destroy jobs*

It's impossible to predict how many jobs AI will take. And, we think AI will create and enhance far more jobs than it eliminates.

However, the danger is always present that AI will get good enough at enough tasks to cause widespread job loss and long-term unemployment.

2) *AI does not have common sense*

It's the skill that prevents people from putting their hand on a hot stove or stepping out into traffic when they see a car coming. Most people learn these things as children and develop this knowledge as they grow. This is also what's necessary to teach common sense to artificial intelligence

3) *Lack of empathy*

AI systems might not demonstrate empathy as found in a human, but programmers are teaching them how to identify emotions and perceptions. This sort of programming, especially when paired with natural language processing systems that can better understand human speech, creates something that can respond to input or stimuli with artificial emotions

4) *AI can not be creative*

A robot could likely create a perfect replica of any famous work of art or play a symphony without missing a note when paired with an AI database, but they cannot create something new [4].

The world's AI technology is still far from the human-like intelligence portrayed in popular science fiction.

Despite all the hype, most AI computers are designed to be very good at solving a specific problem in the context of a very particular data system. Human creativity, insight, and contextual awareness, on the other side, are key to making AI work.

We can sum up that AI's abilities will complement us, rather than replicate us. That is why top-tier and forward-thinking organizations start using AI to enhance organizational agility, productivity, and experiences.

Overall, we can see the potential that more jobs will be created with further AI development. Someone has to create all those AI robots and all other possible types of algorithms. Moreover, people will have more opportunities to try new jobs that do not exist yet.

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ELECTRICAL SCHEME AND SELECTION OF THE ELEMENT BASE OF THE FUNCTIONAL UNITS OF THE ION-LABEL AIR FLOW METER FOR REVERSE FLOWS

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Abstract. The article considers the features of the circuit design of functional units of an ion-label air flow meter for reversible flows in supply and exhaust ventilation systems. Recommendations are given on the choice of the element base.

Keywords: flow, ion label, amplifier, electrode, generator, integrator, comparator, microcontroller, resistor, capacitor.

ЭЛЕКТРИЧЕСКАЯ СХЕМА И ВЫБОР ЭЛЕМЕНТНОЙ БАЗЫ ФУНКЦИОНАЛЬНЫХ УЗЛОВ ИОННО-МЕТОЧНОГО РАСХОДОМЕРА ВОЗДУХА ДЛЯ РЕВЕРСИВНЫХ ПОТОКОВ

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Аннотация. В работе рассматриваются особенности схемотехнического построения функциональных узлов ионно-меточного расходомера воздуха для реверсивных потоков в приточно-вытяжных системах вентиляции. Даются рекомендации по выбору элементной базы.

Ключевые слова: расход, ионная метка, усилитель, электрод, генератор, интегратор, компаратор, микроконтроллер, резистор, конденсатор.

In relation to the tasks of measuring the air flow velocity and operating conditions characteristic of many objects, converters based on unipolar ion labels are the most promising. The latter is a local area of the air flow with an increased concentration of unipolar ions formed as a result of a short-term spark

discharge produced in the incoming flow. Such a label can be formed in a small volume of flow, and its gas-dynamic properties practically do not differ from the properties of the air medium, which ensures full compliance of the parameters of the movement of the label with the characteristics of the airflow.

An important advantage of unipolar ion tags is the possibility of their registration in a non-contact way, namely with the help of metal electrodes, on which, due to the effect of electrostatic induction, a pulse signal is induced during the passage of a charged tag. In this case, the electrodes can be isolated from the flow by a dielectric material, which ensures high reliability of the converter when exposed to moisture, dust, etc. [4].

The ion label generator, performed as a source of pulsed high voltage, outputs a pulse that is applied to the spark gap [3].

It is advisable to build a high-voltage pulse generator according to the scheme shown in Figure 1.

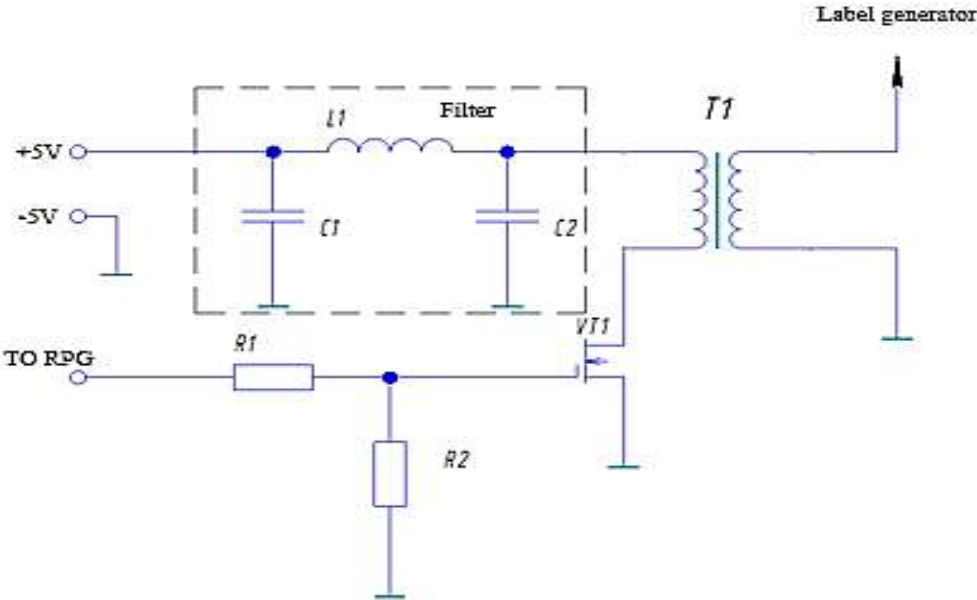


Figure 1. Generator of high-voltage pulses

The electrical diagram of the recorder is shown in Figure 2. Terminals 1 and 2 are connected to the recording electrodes. Informative signals that come from the recording electrodes during the flight of the base distance mark are pulses of induced current of small magnitude, with an amplitude of about 10^{-9} A. Since these signals are small in amplitude, they need to be amplified. For this purpose, current amplifiers or operational amplifiers are used.

Due to the smallness of the input resistance, the current amplifier has practically no reverse effect on the circuit in which the current is measured. In addition, the influence of the capacitance of the connecting lines is eliminated, since this capacitance is connected in parallel to the low input resistance of the current amplifier and therefore the time constant due to it is very small. The output resistance of the current amplifier is small, as with any voltage feedback amplifier.

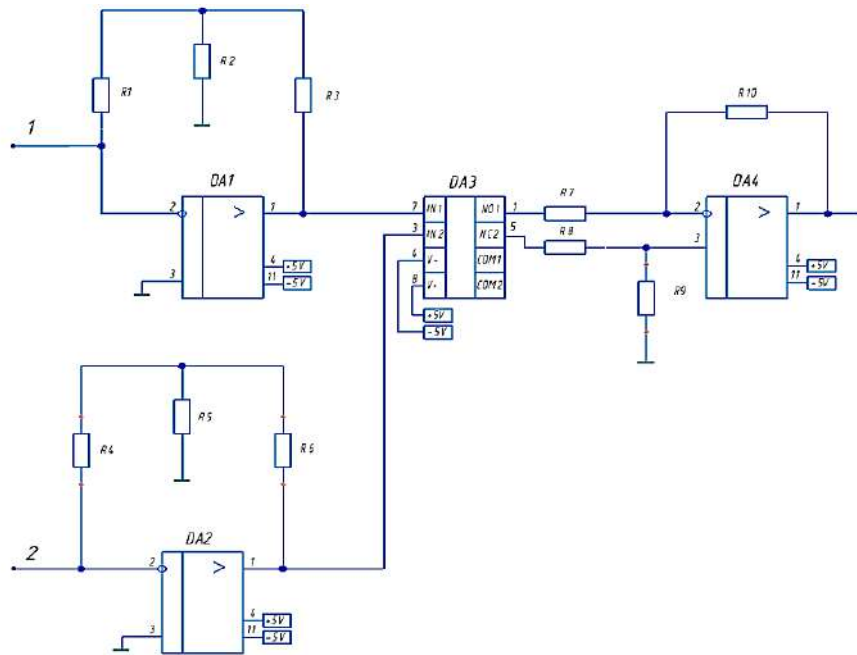


Figure 2. The label recorder

Therefore, it is necessary to select operational amplifiers DA1 and DA2 with a large input impedance. To reduce the overall dimensions, we will focus on the operational amplifier K1464UD2 [2]. The DA3 key is connected to the microcontroller via ports COM1 and COM2, with the help of it, the signal coming to the differential amplifier (remote control) is controlled [1].

K1464UD2 is a quad micro-power operational amplifier designed to operate in a wide voltage range from a single power source. It is also possible to work from a source with bipolar power. The IC contains:

- a current stabilization circuit with a start-up circuit;
- four independent operational amplifiers.

The foreign analogue is the LM 324 IC of the National Semiconductor company.

The voltage U_1 and U_2 from the outputs of the amplifiers DA1 and DA2 are supplied to the inputs of the differential amplifier DA4. The difference signal from the output of the differential amplifier goes to the integrator DA5, which is a low-pass filter, and then to the comparator DA6, based on the LMV331.

The output voltage of the comparator can only be at standard levels: logical 0 (-0.5 - +1.4 V) OR logical 1 (3 - 5 V). A comparator is considered balanced if its output voltage is in the range of 0.7-1.4 V (for an op-amp, the output voltage must be zero). Due to the reduction of the amplitude range, the speed of the comparator is higher than the speed of the standard op-amp, the response speed is about 50ns.

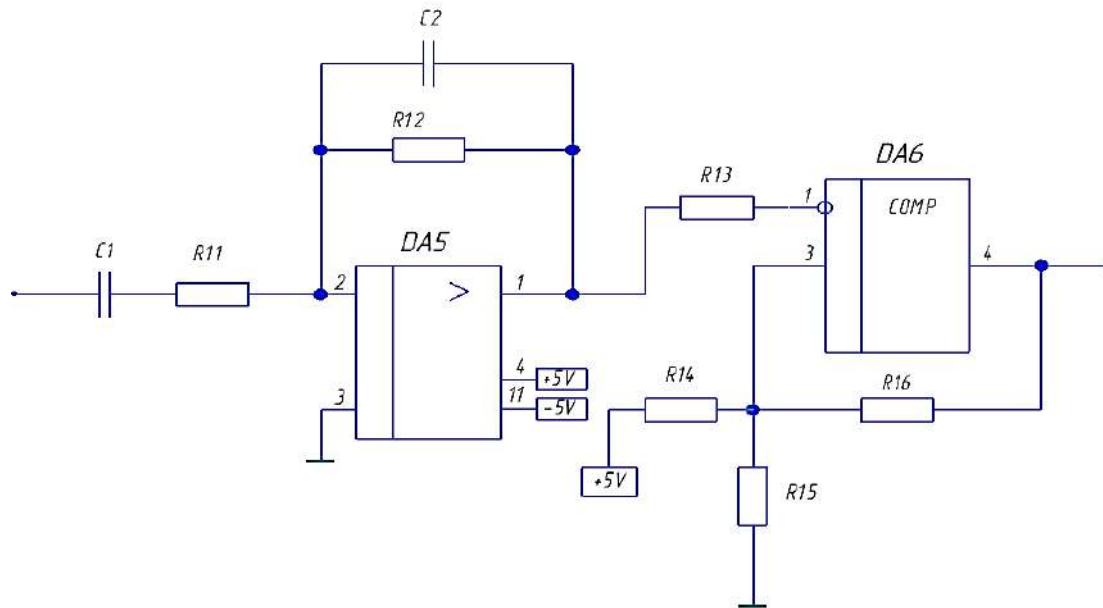


Figure 3. Integrator and comparator

The analog key DA3 is necessary to open the circuit at the start of the measurement in order to eliminate interference from the control unit at the input of the remote control. 2 analog keys are required. To reduce the dimensions, a two-channel precision analog key with a single-pole power supply MAX322CPA is used.

COM1 and COM2 are switches, inputs IN1 and IN2 are fed signals from recorders, output signals will come from ports NO1 and NC1.

The main element of the electrical circuit is the ATmega328P microcontroller.

The developed air flow meter for reversible flows contains eight devices (PU, AK, DU, INT, COMP, MK, GVI, USB-UART transducer) based on 5 operational amplifiers and 3 microcircuits.

The pre-amplifiers, differential amplifier and integrator are based on the operational amplifier K1464UD2.

The analog keys are based on the MAX322 chip.

The comparator is made on the LMV331 chip.

The generator of high-voltage pulses is executed on a field-effect transistor IRLML6344.

To transfer the processed information to the computer, communication is organized via USB. For this method, a USB-UART converter on CP2102 is used.

All other elements play a secondary role, but at the same time they are important to ensure a stable output signal.

The measurement channel consists of a receiving tube in which a spark gap and 2 ion label receivers with 4 differential recorders are located.

From the first and second receiver, the signals go to the pre-amplifiers K1464UD2. The microcircuits are micro-powerful multifunctional operational

amplifiers with adjustable current consumption, with internal frequency correction and short circuit protection of the output.

In this paper, the features of the circuit design of functional units of an ion-label air flow meter for reversible flows in supply and exhaust ventilation systems were considered. In further research, it is necessary to complicate the functional nodes, while using a more modern element base, in order to obtain high accuracy and reliability.

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OPPORTUNITIES FOR THE STUDY OF PERSONAL DEVELOPMENT OF PRIMARY SCHOOL STUDENTS USING PROJECTIVE METHODS

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Abstract. The possibility of obtaining objective knowledge about the person, his inner world, hidden from unknown sources, has always fascinated researchers and forced them to look for new ways to solve one of the fundamental problems of the science of psychology. Therefore, the first monographs in the country on projective methods of personality research should not be ignored. The relevance of the topic is considered in the absence of the same literature and research.

Keywords: methods of psychology, projective methods, personality research.

ВОЗМОЖНОСТИ ИЗУЧЕНИЯ ЛИЧНОСТНОГО РАЗВИТИЯ МЛАДШИХ ШКОЛЬНИКОВ С ИСПОЛЬЗОВАНИЕМ ПРОЕКТИВНЫХ МЕТОДОВ

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Аннотация. Возможность получения объективных знаний о человеке, его внутреннем мире, скрытых в неизвестных источниках, всегда завораживала исследователей и заставляла их искать новые пути решения одной из фундаментальных проблем науки – психологии. Поэтому не следует игнорировать первые в стране монографии по проективным методам исследования личности. Актуальность темы рассматривается в отсутствие аналогичной литературы и исследований.

Ключевые слова: методы психологии, проективные методы, исследование личности.

Projective diagnostics provides detailed information about the personal development of a child of primary school age in society. Diagnosis of personal development of a preschool child as an integral part of psychological support will allow you to provide timely assistance to the child in addressing pressing issues of personal development and socialization in the future. Let's consider

theoretical approaches to the use of projection methods in the psychological diagnosis of personal development of a child of primary school age.

Frank writes that the study of personality reveals a unique, personal way of organizing experience and feelings. In order to carry out the tasks of studying the personality, L. K. Frank points out the need to choose different methods that allow you to reveal your personality [1]. According to him, the projection methods are aimed at revealing to the subject that “he can not speak or can not speak” often due to ignorance and unconscious revelation of himself through projections. It is worth noting that the use of projection in play allows to reveal the personality of the child. To diagnose the child's personality, he suggests the use of games with objects, as well as unstructured materials (clay, flour, water, laundry, etc.). The use of games for diagnostic purposes in working with preschool children is even earlier in the works of M. Klein, A. Freud. We have obtained similar interpretations of the purpose of the use of projection methods not only in Makhover, but also in S. Levid [2] and later in E.T. Sokolova. The stability of projection images in children is determined by repeating the diagnostic procedure and longitudinal examination. Projective methods can be used for clinical examination of the face and the formulation of a psychological diagnosis.

A. F. Korner [2] begins with the psychoanalytic concept. In this theory, it is important to pay close attention to the competence of the researcher: to know what qualities of the individual can reveal a particular projection method. For an objective description of the capabilities of projective methods A. F. Corner compares them with questionnaires, noting that the projection methods are carried out with the help of special.

Incentive materials create more space for the child to express himself. Demonstrates that projective methods can be used to identify personality traits (anxiety) and disorders (theft), as well as relationships with parents. However, he believes that projective play methods do not provide predictive information about the child's actual behavior (aggression). A. Anastasi considers projection methods as the most effective procedures for revealing hidden, hidden or unconscious aspects of personality [3].

L. F. Burlachuk, S. M. Morozov (1989, 2000) offers another definition: projection methods – a set of methods aimed at the study of personality (from the Latin *projectu* – throwing forward) and developed as part of the projection diagnostic approach; a set of methods for the study of personality as a whole, based on the psychological interpretation of the results of projection.

Here is another definition that indicates the importance of a particular projection situation, as well as the properties that allow you to determine the projection methods. Projective methods are methods of mediated research of the person based on the creation of a real, plastic (weakly structured) stimulating situation that contributes to the actualization of the perception of trends, attitudes, relationships and other personal qualities [4].

Projection is considered as an act of perception, the appearance of the person in the perception, as a reflection of the past in the practice of practical action and in the emotional sphere (S. L. Rubinstein, L. F. Burlachuk).

Individual research on the use of projection methods in working with preschool children does not exhaust all the depth of the problem of studying the possibility of using projection methods to determine the characteristics of the child's personality. The principle of proving the concept of "projection" in domestic psychology is a conceptual position on the activity of the perceptual process, its individual nature, including changes in personal attitudes, tendencies, motivations (V. M. Bleicher, L. F. Burlachuk, E. T. Sokolova). Analysis of the psychological and pedagogical literature shows that most research in psychodiagnostics is aimed at considering different groups of general psychological methods. At the same time, it is noteworthy that there is a lack of research that reveals the essence of projection methods and the specifics of their use in the psychodiagnostic examination of children of primary school age. The available works are mainly limited to the presentation of individual facts related to the history of the emergence and development of this group of methods or the use of individual projection methods.

In the theory of motivation, K. Goldstein refers to the concept of "leading patterns": it is a person who creates with repeated repetition, corrected and structured formation, which is the leading motives, desires, interests, values, feelings, features. . This area can be diagnosed using projection methods [2].

It is difficult to disagree with the opinion of S. Levi [2] that it is necessary to use all the data obtained in the process of projection research ("Human Image" test, which helps to describe and understand a person's personality. rather, its purpose is to achieve an understanding of the individual through research. The interpretation should be based on the whole model of image analysis as one of the areas of diagnostic reliability.

With the help of projection techniques "Wood", "House – tree-man" (J. Beck, E. Jukkert, J. Schliebe, P. Bura, R. Stora) the structural connections of personality elements are studied by projection [2]. With the help of objects of traditional cultural significance (house, tree, person), interpersonal, intra-family relations, the intellectual sphere of the whole person is diagnosed. The results of the test "Home – tree-man" for parents of children with personality disorders are analyzed together with the history of socio-psychological development and used in the course of family therapy. The addition of color to the "Home – Tree – Man" test removes a lot of protection from the child and reveals hidden reactions, which, of course, helps to understand the emotional sphere (J. Payne).

We found that the projection method focuses on the study of unconscious (or not conscious) forms of motivation. The advantage of this ability is that it is the only correct psychological way to penetrate the closest area of the human psyche. Projective methods are almost universal for age categories. One of the big "+" is the ability to use them from preschoolers to the elderly. We have developed classifications of projective methods by Frank and G.M. Proshansky. The Frank classification, in spite of many others, with the changes and additions

proposed later, is the most complete description of the projection technique today [5; 6; 7].

Studying the features of the use of projective methods and the specifics of their implementation, we have a number of requirements and rules that are directly related to the effectiveness of projection methods. A very important factor in the interpretation of the data obtained with the help of projective technology is the translator himself. In world practice, it is considered adequate to interpret the data obtained by a professional with psychological or sociological knowledge using projection methods and qualitative research experience.

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COMPARISON OF PREPARATIONS BASED ON ω -3 AND FISH OIL: WHAT TO CHOOSE?

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Abstract. The article discusses the useful properties of ω -3, the composition of fish oil. A comparison of fish oil and preparations based on ω -3 is presented.

Keywords: fish oil, polyunsaturated fatty acids, linoleic acid (ω -6), alpha-linolenic acid (ω -3), vitamin A, vitamin D.

СРАВНЕНИЕ ПРЕПАРАТОВ НА ОСНОВЕ ω -3 И РЫБЬЕГО ЖИРА: ЧТО ВЫБРАТЬ?

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Аннотация. В статье рассматриваются полезные свойства ω -3 и состав рыбьего жира. Представлено сравнение рыбьего жира и препаратов на основе ω -3.

Ключевые слова: рыбий жир, полиненасыщенные жирные кислоты, линолевая кислота (ω -6), альфа-линоленовая кислота (ω -3), витамин А, витамин D.

The human body has a constant need for polyunsaturated fatty acids (PUFA). They are essential nutrients, but they are not produced by the body and enter it only with food. The beneficial properties of ω -3 include:

- strengthening immunity;
- regulating the work of all organs and systems;
- transmitting impulses in nerve cells;
- stimulating the production of serotonin;
- protecting the respiratory system from infections;

- strengthening the walls of blood vessels, as well as protecting them from excess cholesterol, which is called “bad”, preventing the formation of cholesterol plaques;
- improvement of blood clotting;
- normalization of blood pressure;
- reduction of homocysteine concentration, prevention of blood clots and related problems;
- strengthening of the bone system, removal of inflammation and relief of joint pain;
- prevention of destruction of articular cartilage, improvement of joint mobility;
- improvement of the bronchi in smokers;
- normalization of the menstrual cycle;
- prevention of the formation of tumors in the intestine, genitourinary system and mammary glands;
- anticarcinogenic effect;

Possible signs of ω -3 deficiency include:

- dry skin;
- brittle nails and hair;
- sleep disorders;
- problems with concentration;
- joint pain;
- rapid fatigue [1].

To make up for the lack of fatty acids, it is recommended to eat the products in which they are contained, namely flaxseed and hemp oil, sea fish (trout, tuna, salmon, mackerel), seafood, spinach, soy, walnuts. However, such products are usually found in the human diet in insufficient quantities. Therefore, over time, the body begins to experience a deficiency of PUFA. To make up for it, you have to use fish oil and ω -3 capsules.

What is fish oil?

This is a complex dietary supplement, which is obtained most often from the liver of cod. It is also found in the meat of herring, mackerel and other oceanic fish species, is a source of vitamin D. Fish oil is almost not found in food, but is needed for the work of cartilage and connective tissue, improving the structure of bones. It includes vitamin A, which plays an important role for the organs of vision. Fish oil also contains ω -3 and 6 PUFA [2].

In the domestic pharmaceutical market, you can find a substance that is used for medical purposes and additives with different concentrations of active ingredients. In addition to vitamins, fish oil and ω -3, they may contain various impurities (vegetable oils, extracts, etc.).

Doctors recommend using only the medical form of the substance. It goes through several stages of purification; therefore, it does not contain heavy metals, nitrogenous derivatives, ammonia, mercury.

Consider the composition of fish oil:

Vitamin A is an anti-infective vitamin. It is necessary to maintain the integrity and functioning of the epithelium. Vitamin A is necessary for our body to maintain good vision, maintain the health of hair, skin, mucous membranes of the respiratory tract and digestive system, has a positive effect on the growth of bone tissue and tooth enamel, and also has antioxidant properties.

Vitamin A deficiency leads to metaplasia, in which the epithelium of the bronchi and bladder can be transformed into a multilayer squamous epithelium. Vitamin A is indispensable for vision. Even with a mild vitamin deficiency, epithelial function may deteriorate. A significant deficiency of this vitamin can lead to blindness; In a number of developing countries, the rates of in-hospital mortality among children with blindness due to vitamin A deficiency reach 15-25 %. Moderate vitamin A deficiency causes chicken blindness (hemeralopia).

Vitamin D takes an active part in maintaining mineral homeostasis in the body: regulates phosphorus-calcium metabolism, promotes the penetration of phosphorus and calcium into the cells of the body, preserves and maintains the optimal structure of bones and teeth; prevents increased nervous excitability and convulsive twitching in the leg muscles. The leading function of vitamin D is to ensure the normal growth of bone tissue – its adequate mineralization. It strengthens the immune system. The susceptibility to skin diseases and heart diseases depends on the presence of vitamin D in the body. In addition, it participates in lipid metabolism, blood pressure regulation, etc.

Polyunsaturated fatty acids (PUFA) are not produced in the human body, so their only source is food, especially fatty fish. Essential fatty acids include linoleic acid (ω -6) and alpha-linolenic acid (ω -3). ω -6 and ω -3 long-chain PUFA (LC-PUFA) are structural and functional components of cell membranes. In addition, LC-PUFA are precursors of eicosanoids, which regulate hormonal and immune activity of the body.

In the course of human evolution, the ratio of ω -6-fatty acids to ω -3 in the diet was approximately 1:1. The physiological state of the cell is optimal at a ratio of 3:1 between ω -6 and ω -3 fatty acids. However, at present, residents of European countries have increased this ratio to 10:1 and even to 20:1. It has been established that ω -6-fatty acids increase the level of pro-inflammatory molecules in the body, while ω -3-fatty acids cause an increase in anti-inflammatory molecules in the body. Therefore, the diet of modern residents of Western countries can be considered as a diet that probably contributes to the development and maintenance of a number of inflammatory reactions in the body.

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During human evolution, the ratio of ω -6-fatty acids to ω -3 in the diet was approximately 1:1. The physiological state of the cell is optimal with a ratio of 3:1 between ω -6 and ω -3 fatty acids. However, at present, residents of European

countries have increased this ratio to 10:1 and even to 20:1. It has been found that ω -6-fatty acids increase the level of pro-inflammatory molecules in the body, while ω -3-fatty acids cause an increase in anti-inflammatory molecules in the body. Therefore, the diet of the new generation of European countries can be considered as a diet that probably contributes to the development and maintenance of a number of inflammatory reactions in the body.

The human body is not able to convert ω -6-fatty acids into ω -3-fatty acids and vice versa. Consider the interesting properties of the long-chain ω -3 fatty acids eicosatetraenoic (EPA) and docosahexaenoic (DHA). The vasoprotective properties of long-chain ω -3-fatty acids were revealed. EPA and DHA affect lipid metabolism, vascular tone and blood clotting. Due to their anti-inflammatory effect, they have a positive effect on the course of the inflammatory process in a number of systemic connective tissue diseases, including rheumatoid arthritis.

It has been established that ω -3-fatty acids play a leading role in the functioning of the central nervous system throughout a person's life. The effect of fatty acids ω -3 and ω -6 on the development and functioning of nervous tissue is due to their participation in numerous processes, including gene transcription, regulation of effects in the process of cellular signaling, as well as the effects of membrane permeability.

A lack of ω -3 fatty acids or an imbalance between ω -3 and ω -6 fatty acids is associated with numerous behavioral abnormalities, especially in children, including mental disorders. Numerous clinical studies demonstrate a link between disorders of neuropsychiatric development of children and an imbalance of ω -6 and ω -3 fatty acids. Neurocognitive disorders such as attention deficit hyperactivity disorder (ADHD), dyslexia, dyspraxia and autism are often associated with a lack of ω -3 fatty acids [3].

ω -3 preparations and their use:

ω -3 capsules are an easy-to-use product that has been thoroughly cleaned. Therefore, due to the lack of taste and smell, unlike fish oil, ω -3, according to user reviews, is more comfortable to take. Drugs ω -3 meet several criteria [4]:

- ensure the intake of a sufficient amount of ω -3 in the body (at least 1 g / day);
- contain ω -3 more than ω -6.

ω -3 medications, like regular fish oil, can be bought at a pharmacy. They are well absorbed, practically have no contraindications and side effects.

How is ω -3 different from fish oil?

Table 1 – Comparison of Preparations based on ω -3 – PUFA and fish oil [4]

Preparations based on ω -3 - PUFA	“Fish oil”
It consists only of nutrients necessary for the body	A lot of unnecessary substances, in particular saturated fats and impurities. It may contain toxins if it is made from cheap raw materials.
The capsules are sealed. The contents in them do not oxidize and retain their properties over time.	Liquid fish oil is oxidized in the air and eventually loses its properties
A tasteless shell that dissolves only in the stomach characterizes capsules.	It has a specific fishy smell and taste that not everyone likes.
Capsules contain the necessary concentration of nutrients. This makes it impossible to overdose.	It is necessary to accurately measure the dosage. The smell may remain on the dishes.
The cost is medium and high.	Low cost.
Availability: Can be purchased at a pharmacy or online store.	Availability: you can buy it at any pharmacy.

When a doctor talks about the need to take fatty acids, many immediately remember fish oil. But it is not quite right to draw such a parallel, since there are several differences between ω -3 and a substance that is obtained from the liver, fat or muscle tissue of fish:

- Composition. ω -3 preparations are a pure source of polyunsaturated acids, and in the substance obtained from the liver or tissues of fish, besides them there are “impurities”.

- Origin. Fat is obtained exclusively from sea fish, and fatty acids can be obtained from other products – nuts, flax seeds, chia, sesame, etc.

- Release form. Unlike fish oil, ω -3 is more convenient to use. Capsules have no smell and taste. The shell reliably protects the contents from oxidation, which cannot be said about the substance obtained from fish and seafood. Upon contact with air, it gradually loses its useful properties and becomes dangerous for consumption.

- Cost. Fatty acids in their pure form are somewhat more expensive than ordinary cod liver oil. Especially if we are talking about high-quality medicines based on PUFA ethyl ether.

- Dosage. Only a doctor can tell you how to take fish oil and ω -3. But the use of capsules is more comfortable. You do not need a special measuring spoon to measure the right dose. It is enough to take the amount recommended by the manufacturer or doctor.

When using medical fish oil, there is a risk of hypervitaminosis. If the product has not been properly cleaned, it may contain impurities that are

dangerous when accumulated in the body. Medications in capsules with ω -3 have a fully balanced composition, a clear dosage, so they are very convenient to use [1].

Thus, I personally recommend to use biologically active additives to maintain the necessary level of vitamin A, D, polyunsaturated acids, since they have a full-fledged composition of the necessary concentration of nutrients regulated by doctors, there are no impurities in them and have a more sealed shell.

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HOW AR AND VR TECHNOLOGIES ARE CHANGING THE FASHION INDUSTRY

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Abstract. The article explores modern types of 3D technologies in the fashion business. Authors present a systematic analysis of the emerging interdisciplinary VR and AR fields at fashion industry. The positive and negative changes and the consequences of their introduction into the fashion business are mentioned.

Keywords: 3D technologies, virtual reality, augmented reality, 3D scanner, figital clothing, virtual presentation.

КАК AR И VR ТЕХНОЛОГИИ МЕНЯЮТ ИНДУСТРИЮ МОДЫ

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Аннотация. В статье рассмотрены современные виды 3D-технологий в модном бизнесе. Представлен систематический анализ новых междисциплинарных областей VR и AR в индустрии моды. Выявлены положительные и отрицательные последствия их внедрения в фешн-бизнес.

Ключевые слова: 3D-технологии, виртуальная реальность, дополненная реальность, 3D-сканер, фиджитальная одежда, виртуальная презентация товара.

Digital fashion became a serious phenomenon in 2019 when The Fabricant design group sold a digital dress, i. e., its 3D-model, for USD 9,500 (Figure 1). And then, virtual clothing designer Cat Taylor made 3D replicas of physical collections of Alexander Wang, Selfridges and Balenciaga [1].



Figure 1. Digital dress by The Fabricant

At that time, the essence of these events was simultaneously absurd and revolutionary: a person buys a 3D-model of clothes, but will never be able to wear it in the real life. But everything changed in 2020, during the COVID pandemic: in the conditions of enforced social distancing, virtual or online implementation of fashion has become not just a beautiful concept, but a need. During the pandemic, online sales in the world grew increasingly; at the same time, offline retail significantly suffered (Figure 2).



Figure 2. Growth of online sales in Russia

There has been a boom of collaborations between technological companies and fashion industry; in 2020, all startups in the field of digital fashion (virtual fitting, digital clothing, digital jewelry and virtual fashion shows) were successful and demanded. Introduction of new technologies has led to the growth of a share of online retail and trust to online shopping. Now it is easier

for the consumer to choose an item of the right size and imagine how it will sit on him/her. The standard of life is omnichannel shopping.

The virtual try-one trend was picked up first by representatives of the beauty industry – all leading makeup manufacturers released their own filters for Instagram, SnapChat and even separate applications for trying on and buying makeup (Figure 3).

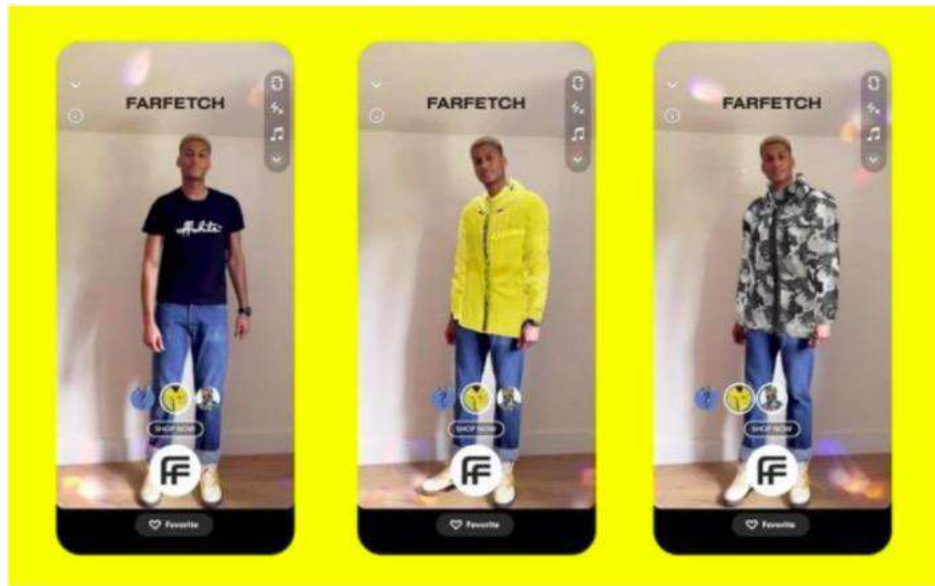


Figure 3. Snapchat x Farfetch collaboration

Belarusian startup Wanna Kicks has made a virtual try-on shoes catalogue, which includes the best samples from Nike, Puma and other brands, as well as collections of retail leaders such as GOAT. Besides, AR-fit technology is successfully used by all companies making top glasses and jewelry. And if six months ago the virtual try-on was available for certain items of clothing only, today the function of tracking body joints is available, which makes possible the movement of clothes together with the movement of the body.

At the stages of major shifts, many players leave the market, and only the ones introducing new technologies in a timely manner remain. Now the race for the use of 3D/VR/AR technologies has begun. According to ABI Research, in 2022 over 120,000 shops in Russia will use the augmented reality functional. Companies should take note of this, since the number of AR-enabled devices will exceed 4 billion. Augmented reality in fashion is changing the way of interaction of companies with customers. This technology allows buyers to get acquainted with products without leaving home. Augmented reality helps consumers understand what they buy, thus making it easier to meet customer expectations. This ultimately leads to a higher level of purchase satisfaction and increased brand loyalty.

At the same time, the spread of digital and figital formats of the presentation of a fashion product is growing. Studies have shown that people

can remember up to 80 % of what they see and only up to 20 % of what they read and 10 % of what they hear [2, p. 70]. These figures show why it is important for companies to use new technologies to ensure even more visually appealing interaction. Virtual presentation is a product of the evolution of photography, effective marketing tool and a possibility to save when designing an item.

Product visualization makes it possible to review a product in more details and make a more informed choice when buying. User receives information on the brand in the virtual space, emotionally contact with it in social networks, through mailing lists, on streaming services and by other communication channels. Immersive experience evokes emotions, which are an important factor in a consumer’s decision to buy a product. Instead of forcing the consumer to imagine how a product will look, augmented reality in fashion allows the user to experience it in the digital environment. The phrase “a picture is better than a thousand words” is the key to marketing and promotional initiatives. According to the studies of Accenture Interactive, 47 percent of consumers admit that immersive technologies make them “feel more product-connected” when shopping online [3].

An image on the network becomes no less important than in the real life. According to the study of Hootsuite, an average person spends about seven hours online every day browsing social networks, playing with friends or shopping. This has given rise to a trend of making products helping to try on unique digital gear so that users could take pictures of themselves with a holographic layer – virtual garments. Both startup inventors and large technological companies are engaged in the process. For example, designers use the Dress-X platform to sell 3D digital versions of their clothing (Figure 4).

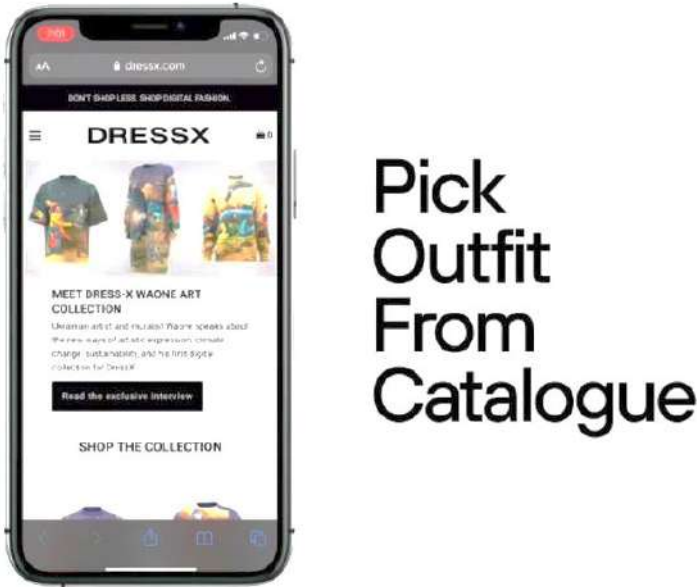


Figure 4. Dress-X digital clothing platform

This year, DressX received the first 2-million dollars’ grant from the Artemis foundation and started testing an application allowing people to try on digital clothing in real time instead of sending pictures for digital clothes. And the Russian company Texel developed its own Telegram-bot allowing to “try on” virtual look on a picture in just a second due to neural networks (Figure 5).

In the future, companies without a virtual product will stay at the low-margin stages of production, while international brands will dominate the market. “Just clothes” will become even cheaper goods, and shopping malls will lose the consumer choosing online shopping. Companies, which have already included digital products into their catalogues, include ZNY, THE, Sintycate, Alena Akhmadullina, Replicant, Malivar, Post Tribe, Now media art, Kruzhok.moscow. According to NTI forecasts, the market of digital products currently amounts to USD 0.8 billion, and by 2035 will grow to USD 142 billion [4].

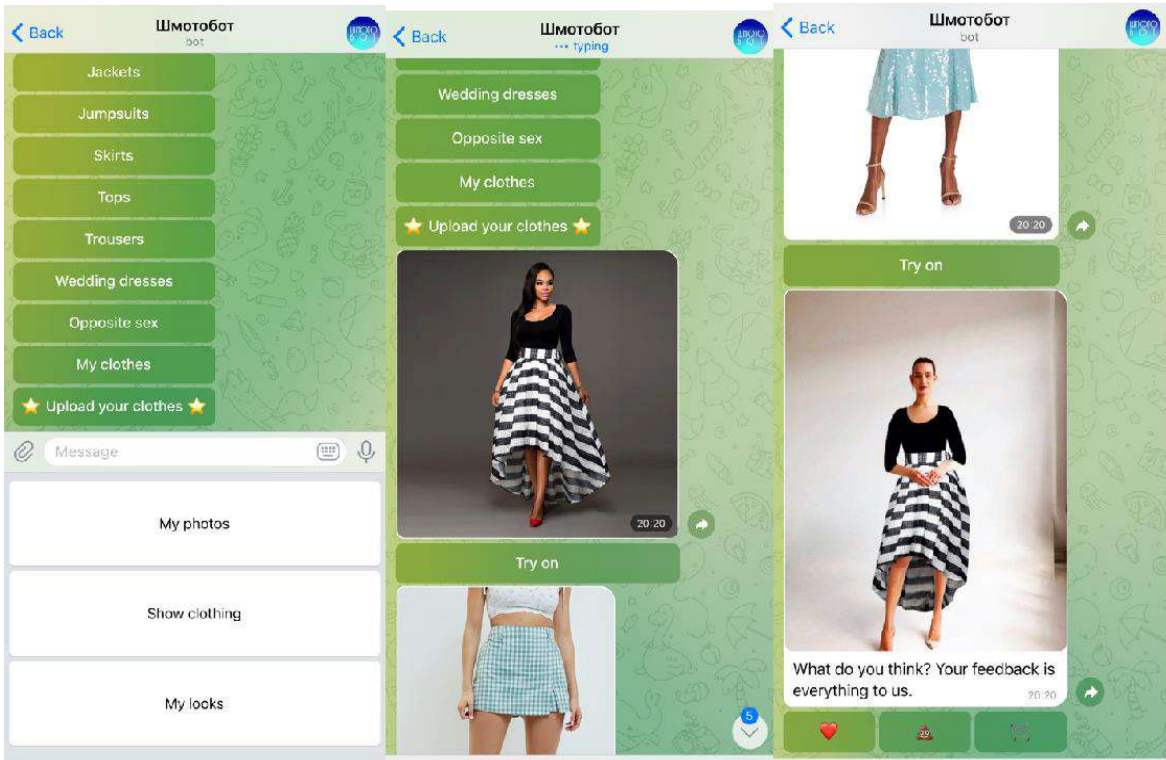


Figure 5. Telegram channel “Shmotobot”

USD 60 billion – losses of companies on returns in 2019. Return of goods in online stores can reach 50 %, processing and record thereof takes time and increases company’s costs. At the same time, 85 % of all online returns resulted from the choice of a wrong size. Difficulty in determining the correct size for a specific manufacturer leads to errors, customers waste time on the complicated return process, which negatively affects the brand image. Besides, returns create about a million tons of waste in landfills annually according to Vogue Business. Fashion desperately needs technologies to solve the “unfit” problem.

Technologies allowing anyone willing to create a digital avatar are available today. This option will allow buyers to choose the right style and size when shopping online. In Russia, full-size body scanners are offered by Texel company. Cost of the simplest black-and-white scanners starts from USD 12 thousand, and full colorful ones – from USD 35 thousand to USD 2 million. There are rates for annual maintenance of unlimited animations; single animation costs about USD 3 per person. The Texel case for Marks&Spencer shows the following results: sales after virtual fitting on the website tripled, while the number of product card views increased 6 times. After size recommendation, conversion increased by 10 %, and returns decreased by about 20 %. Thus, the company’s return on investment ratio increased 7 times (Figure 6). These technologies are relevant not only in the B2C segment, but in the B2B, too. For example, GazPromNeft is already using scanners to provide employees with uniform, since unfit special clothes may cause accidents.

Marks & Spencer CASE STUDY



Figure 6. Marks&Spencer and Texel case

Dynamics of the clothing industry is changing dramatically; digitization is critical for efficient work. Size studies based on primary scanning data allow the brands to plan more reasonably, reducing cycle time and waste. This data can further help design teams to develop clothes directly on the basis of 3D-models. In the future, growth of the number of people with a 3D avatar as an analogue of a photo resulting from the available 3D-scanning will allow manufacture of customized clothes remotely, in the “download your avatar” instead of the “choose your size” form.

Final widget for the website consists of two products:

Size recommendation: the customer enters his/her basic data, including height, weight and age and receives a size recommendation. Also, immediate display of the customer is possible with detailed circumferences instead of a size recommendation.

Virtual fitting: the customer downloads his/her photo and receives visualization of how clothes will look on him/her. Visualization does not reflect the real fit of clothes, but is rather intended for the customer to understand whether he/she likes a specific item on him/her.

Using both products together, the customer becomes able to choose both the right size and specific product he or she visually likes at fitting.

Of course, implementation of solutions for the virtual fitting of clothes will not go without problems. In addition to difficulties such as financial costs and novelty of the technology, there are serious concerns about preservation of the confidentiality of consumers' data collected by companies. Solutions such as mobile body scanning, visual fitting rooms and virtual fitting technology have an additional barrier for the storage of customers' names and addresses, as well as biometric information specified by them. To reduce consumer concerns, solutions should be developed subject to confidentiality, and companies must ensure transparency and security of the storage of customer data [5].

But these nuances will be addressed in the near future, since potential of the virtual 3D-fitting technology to improve the ways of design, sale and consumption of fashionable clothes is enormous – whether reduction of the number of physical samples ending up in landfills or introduction of a virtual fitting room for online retail allowing significant reduction of the percent of returns. [6]. Despite many defects, turbulence of 2021 has caused an increased interest in virtual fashion. Now, designers and brands must master digital technologies, study new possibilities and ensure availability of their products for consumers – both in the physical and virtual world.

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