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“КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ ІМЕНІ ІГОРЯ СІКОРСЬКОГО”

ФАКУЛЬТЕТ ЛІНГВІСТИКИ

‘SIGNIFICANT ACHIEVEMENTS IN SCIENCE AND TECHNOLOGY’

“ВИЗНАЧНІ ДОСЯГНЕННЯ В НАУЦІ І ТЕХНІЦІ”

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Визначні досягнення в науці і техніці («Significant achievements in science and technology»): Матеріали X Всеукраїнської студентської науково-практичної онлайн конференції, 13 листопада 2024 року [Електронне видання]. – Київ, 2024. – 177 с.

У збірнику представлено матеріали X Всеукраїнської студентської науково-практичної онлайн конференції «Визначні досягнення в науці і техніці» («Significant achievements in science and technology»), яка відбулася у Києві 13 листопада 2024 року. Матеріали конференції призначено для студентів, випускників (ЗВО) та усіх, хто цікавиться актуальними питаннями науки та техніки.

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WAYS TO GET ENERGY FROM THE STEPS

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Today shows us how important it is for humanity to do everything possible to extract energy from the world around us without harming it since in this case nature shows us that it is also strong and capable of giving a tough answer. There are many large and cumbersome technologies in the world, such as wind turbines or large fields of solar panels, but they are very expensive and cannot be used everywhere and in large crowds. It is crucial to take advantage of the niche opportunities that are right under our feet right now.

The East Japan Railway (JR East) is experimenting with the latest technologies to tap into the energy of passengers' footsteps. Tokyo's busiest stations have a special tile with piezoelectric elements that converts mechanical energy into electrical energy when people walk on it. The project was launched in 2007 and has continued to develop ever since. The energy obtained in this way is used to power station displays and other low-power devices, with the possibility of further expansion to automatic turnstiles. Piezoelectric Tile technology, which generates energy from steps, has many advantages and can be implemented in various aspects of our lives. A more detailed description of its advantages, and application features are provided further.

Advantages of Piezoelectric Tile technology:

1. Eco-friendliness: generating energy from the steps does not require fossil fuels and does not cause harmful substances to be released into the atmosphere. This makes the technology absolutely environmentally friendly. In large cities with high energy consumption, such a source can significantly reduce the load on traditional energy systems.

2. Efficient use of natural energy: the technology allows you to convert mechanical energy that is normally lost (for example, pedestrian steps) into electrical energy. This ensures efficient use of energy and reduces the need for other energy

sources.

3. Reduction of energy costs: piezoelectric tiles can be used to power lighting systems, advertising displays, electronic devices, or even charge mobile phones. This reduces energy costs in places where these tiles are installed, such as train stations, shopping malls, office buildings, etc.

4. Increasing energy independence: installations with piezoelectric elements can be integrated into autonomous power systems, which ensures the energy independence of facilities in remote or hard-to-reach places where access to conventional energy sources is limited.

Ways to implement technology in everyday life:

1. Public spaces: installing piezoelectric tiles in high-traffic areas such as train stations, airports, shopping malls, stadiums, and subways will allow energy to be used by a large number of pedestrians. For example, Tokyo Metro stations have already implemented a technology that allows them to generate electricity for lighting.

2. Educational institutions: in schools and universities, you can install tiles in corridors or on playgrounds where students are actively moving. This not only generates electricity but can also be used to teach students about renewable energy.

3. Parks and sports grounds: installing piezoelectric tiles on treadmills or tennis courts will generate electricity from people's physical activity. This energy can be used to light parks or power irrigation systems.

4. Urban infrastructure: piezoelectric tiles can be used on road surfaces to generate energy from vehicles that move on roads. It can help power street lighting, road signs, surveillance cameras, etc.

5. Shopping centers and offices: installing such tiles in crowded areas, such as corridors or stairs, will reduce energy consumption and energy costs.

Therefore, the introduction of piezoelectric tiles for energy generation is a promising solution that can significantly reduce energy costs and promote the use of renewable energy sources in the modern world.

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THE SIMULATORS IN ROBOTICS, THEIR INTEGRATION IN OUR LIVES

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The active development of mobile and autonomous robotics over the past decade has helped to find opportunities for their application and solution of problems in the field of Electronics.

Training and working with complex modern robots require simulators. They are a powerful tool for educating and training people, providing a safe environment for practicing and developing skills (Hurrel).

Simulators play a critical role by guaranteeing a safe, effective, and cost-efficient environment for training. They allow users to acquire practical skills and develop critical thinking in a controlled environment. The use of simulation systems has important criteria such as: (Lateef, 2010, p. 348)

- Safety;
- Effectiveness of training;
- Saving resources;
- Standardization of processes;

- Modeling of complex scenarios.

In the modern dimension of simulation systems, there are several main types of simulators, each of which has its own characteristics and applications: (Moiseienko, 2024)

- Live simulations;.

-Virtual simulations;;

-Constructive simulations;

-Gaming simulations.

Considering the manufacturability of modern simulators used in Ukraine, it is necessary to note the use of various advanced technologies to ensure the most realistic and effective training, namely: (Peremot, 2024)

- Virtual Reality (VR) technologies;

- Use of complex mathematical models;

- Augmented Reality (AR) technologies;

- Systems for modeling situational actions;

- Interactive simulators.

These technologies ensure a high level of realism and effectiveness of simulators, which contributes to the professional training of Ukrainian specialists.

Several countries are leaders in the development of multi-sectoral simulators due to their advanced technologies and significant investments in research and development. The world leaders in the development of simulators include Japan, the United States, Canada, Israel, the United Kingdom, Germany, France, China, and Australia.

The use of simulators can significantly reduce training costs, as it does not require the use of real equipment and other resources. By providing a safe environment for practicing complex and dangerous operations, which reduces the risk of human injury during them. This is especially important for beginners when practicing with new tools. Thanks to the use of modern technologies such as AI and machine learning, simulations can be adapted to the individual needs of each student,

providing personalized recommendations and feedback. Resulting in a possibility of training of a large number of students at the same time. Modern simulators allow you to quickly create and test new scenarios, which makes it possible to be prepared for various challenges (Bernatskyi, 2024).

Future simulators will definitely include new technologies that will further increase their efficiency and realism. Promising technologies that may appear in the near future include artificial intelligence (AI), the Internet of Things (IoT), 5G technologies, extended reality (XR), additive manufacturing (3D printing and 3D scanning), robotics, and autonomous systems. These technologies have the potential to significantly improve professional simulations, making them more realistic, interactive, and effective in preparing professionals for current and future challenges.

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UKRAINIAN SCIENTISTS' CONTRIBUTION TO THE DEVELOPMENT OF IT TECHNOLOGIES

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Introduction. Information technology has become an integral part of modern society, influencing economic, scientific and social development. Ukrainian scientists play an important role in the development of this sector. Thanks to their research and innovations, the IT industry is growing rapidly both in Ukraine and abroad.

Key achievements of Ukrainian scientists in IT. One of the most famous Ukrainian scientists who has made a significant contribution to the development of information technology is Serhiy Lebedyev. He developed the SECM (Small Electronic Computing Machine), the first electronic calculator in Europe. Built in 1951 at the Kyiv Electrotechnical Institute, the SECM was the world's first programmable electronic calculator and is considered to be one of the world's first programmable electronic computers. S. Lebedyev also developed the basic principles of computer architecture (Комп'ютерний геній, 2014).

Mathematician Borys Hniedenko made a significant contribution to probability theory and statistics, which are widely used in machine learning and data processing algorithms. His work has had a significant impact on the development of artificial intelligence (Institute of Mathematics, 2021).

Max Levchin is a Ukrainian-born entrepreneur who co-founded PayPal, a well-known payment system that revolutionized online commerce. Max Levchin was born in Kyiv but emigrated to the United States as a child. In 1998, he co-founded PayPal with Peter Thiel and Elon Musk, which quickly became a global leader in electronic payments. Volodymyr Mikhalevich is a programmer and scientist. His work in optimisation and systems analysis was applied to management information systems and logistics. His research helped to develop algorithms for efficient resource allocation and system optimization (Zomkovskyi, 2024).

Modern innovations and development prospects. Today, Ukrainian scientists continue to contribute to the IT sector, especially in such promising areas as artificial intelligence, blockchain and cybersecurity. The most well-known Ukrainian company conducting research in these areas is SoftServe (SoftServe, 2020). The company works closely with Ukrainian scientists and engineers to promote the development of new technologies.

Ukrainian startups in the IT sector that have gained popularity in the international market. For example, “Grammarly” is a product developed by Ukrainian programmers that uses artificial intelligence algorithms to improve written English. This innovative technology has helped millions of users around the world. It is a testament to Ukrainian engineering expertise. “Looksery” is a Ukrainian startup founded in Odesa in 2013 by Viktor Shaburov and Yuriy Monastyrshyn. The mobile app they developed allows users to apply effects and masks to video chats in real time (Єгорова, 2022).

Conclusion. The contribution of Ukrainian scientists to the development of information technology is significant and multifaceted. From the early stages of creating computers to modern developments in artificial intelligence and cybersecurity. The future of the Ukrainian IT sector directly depends on further support for science and technology and the integration of Ukrainian scientists into the global research process.

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PROTECTION AND RATIONAL USE OF LAND

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Land protection is a system of legal, organisational, economic, technological and other measures aimed at rational use of land, prevention of unjustified withdrawal of agricultural land for non-agricultural purposes, protection from harmful anthropogenic impact, restoration and improvement of soil fertility, increase of productivity of forestry land, ensuring special regime of use of land for environmental protection, health improvement, recreation, and historical and cultural purposes. (Land management and land protection, 2019)

Soil is one of the most important components of the earth – a very complex and often underestimated element teeming with life. Unfortunately, the way we currently use land and soil in Europe and the world is not sustainable. This has a significant impact on life on land. (Bruyninckx, 2019)

Effective land management is one of the top priorities today. The problems of efficient use of land resources are closely related to the lack of clear property distribution, imperfect land cadastre and lack of effective control. Growing anthropogenic pressure exacerbates these problems, threatening the ecological balance. Despite the awareness of the problem, practical steps to address it are insufficient.

The agroecological potential of the soil characterises its ability to provide high and stable crop productivity and maintain ecological balance. It is determined by a set of physical, chemical and biological properties of the soil, as well as natural and anthropogenic factors that affect its condition. The main indicators of agroecological

potential include:

−Physical properties: thickness of the humus horizon, mechanical composition, structure, density.

−Chemical properties: content of organic matter, nutrients, acidity, salinity.

−Biological properties: biomass of microorganisms, enzyme activity.

−Water regime: humidity, seepage, drainage.

−Erosion and degradation: the degree of soil damage by erosion, salinity, and pollution (Afanasiev & Kasyanov, 2021).

Agricultural land and semi-natural lands continue to be occupied by cities, and commercial and industrial facilities. Many sectors – industry, agriculture, households, and even wastewater treatment – also release pollutants to the land and soil. These pollutants can accumulate in the soil and then leach into groundwater, rivers and seas. Even pollutants that are initially released into the atmosphere can eventually settle on the ground. Today, traces of various pollutants are found even in the most remote corners of our continent.

In the course of economic activity, land has become a means of production. Compliance with environmental requirements is a prerequisite for all land users and landowners, as the level of socio-economic development of the region depends on the organisation of rational management. Everyone's well-being depends on the efficient use of land, as it is our habitat and source of life.

The following key areas of improving the economic efficiency of land use in agriculture can be identified:

−a system of measures to improve land fertility;

−protection of soils from erosion and other destructive processes;

−reduction of the area of land that falls out of agricultural turnover.

The efficiency of agricultural land use depends to a large extent on the level of profitability of agricultural enterprises, but their financial interests should not lead to a deterioration of the properties of land resources as the main means of production in agriculture.

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WAR-RELATED ECOLOGICAL PROBLEMS OF WATER RESOURCES

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Environmental issues related to water resources in Ukraine are among the most pressing challenges, especially against the backdrop of the full-scale Russian invasion which broke out on February 24, 2022. As an essential natural resource, water is crucial for sustaining human life and maintaining ecological balance. However, during hostilities, water resources and related infrastructure are severely damaged, posing a serious threat to society and the environment.

The war has been at the core of significant damage to Ukraine's water infrastructure, especially in industrial areas. Ukraine's water supply system includes large reservoirs, hydroelectric power plants and irrigation canals, most of which are located in the south and east of the country where the active military actions continue. The destruction of this infrastructure has regional and global implications, affecting not only the local population but also global food security.

In addition to the direct impact of hostilities, climate change is another important factor that exacerbates environmental problems. High temperatures,

droughts and other climatic anomalies further exacerbate the situation with water resources. Combined with the consequences of warfare, such as water pollution caused by the destruction of industrial facilities, this creates a serious environmental crisis.

In the Ternopil region, artillery shelling destroyed mineral fertilizer tanks, leading to an increase in ammonia and nitrate levels in the water, killing large numbers of fish. Such cases show that the fighting directly affects the quality of drinking and agricultural water.

Another notable problem is the lack of wastewater treatment facilities in areas where the war has destroyed vital infrastructure. A vivid example is the destruction of the Kakhovka Hydroelectric Power Plant on June 6, 2023. With the power plant having been undermined, the Kakhovka reservoir was depleted by almost 70%, an area of 600 000 hectares has faced irreversible consequences and the nearby regions of Dnipropetrovsk, Kherson, Mykolaiv, and Zaporizhzhia have also felt the outcomes. According to the latest estimates, the financial damages already exceed the amount of $4 billion.

The power plant destruction has also caused the total collapse of hydraulic structures, leading to the contamination of wastewater flows into rivers and water bodies, affecting the environment and public health. For example, the Kakhovka Reservoir was contaminated after the wastewater treatment plant near Zaporizhzhia stopped functioning, a situation that could have long-term consequences for agriculture and water quality in the region.

Furthermore, it is worth noting that many of the environmental problems related to water resources in Ukraine predate the outbreak of the war. The water quality in the Dnipro River is reportedly in a critical state due to ongoing pollution from industrial waste and the lack of proper water treatment infrastructure. The lower reaches of the Dnipro are in a particularly poor state, which negatively impacts fisheries and biodiversity. Thus, it is important to address the war-related problems as soon as possible.

One of the most important recommendations is the need to engage international

partners to rebuild water infrastructure. In particular, it is about installing treatment systems in hospitals, schools and other socially important facilities.

While temporary drinking water supplies may be necessary for a certain period of time, a more sustainable solution is to introduce modern treatment technologies and provide each household with a water treatment plant.

Another important aspect is the development of modern legislation to protect water resources and the introduction of innovative technologies for their conservation. That is why the website of the Ministry of Environmental Protection and Natural Resources of Ukraine has created a reform called "Integrated Water Resources Management", which aims to ensure equal access to quality and safe drinking water and proper sanitary and preventive measures.

Summing up, with the provision of water resources being disrupted and water infrastructure being damaged, it is of the utmost significance to take measures to address this issue.

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THE GREATEST ACHIEVEMENTS OF THE PAST, PRESENT AND FUTURE

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Technological breakthroughs are significant innovative achievements that lead to radical changes in society, economy and culture in terms of doing business, communication, education, health care and other areas of life. They expand human capabilities, allowing the achievement of what previously seemed impossible, and often become the basis for global change. Technological breakthroughs at different times have different consequences for the world.

To begin with, let's start with the greatest breakthroughs of the past, so let's consider the steam engine first. The inventor of the steam engine (piston steam engine) is considered an englishman James Watt, who received his first patent for a direct-acting steam engine in 1769. For clarity, a steam engine is any heat engine that converts steam energy into mechanical work.

And then, after the rapid outbreak of industrial revolution, it was a transition from manual manufacturing to machine production, which ended with the creation of a universal engine. During almost the entire 19th century the steam engine determined the energy level of machine production and transport, the pace and direction of their development. The steam engine increased the need for hard coal and satisfied this need because it lifted the coal from the mines, ventilated them, and pumped water out of them. Based on the experience gained in the production of steam engines, a new piston engine was created, which will be discussed later.

On August 6, 1801, the French engineer and professor of mechanics at the School of Bridges and Roads in Paris, Philippe Lebon, issued a patent for the construction of a gas engine. The driving force arose after the explosion of the gas-air mixture inside the working cylinder – the internal combustion engine (ICE) appeared in mankind. The Belgian Jean Etienne Lenoir in 1860 continued the work after the

death of Lebon, who built a gas engine according to personal drawings in 1860, in which the ignition of a combustible mixture was carried out with the help of an electric spark, as it is now. The normal operation of the engine was hindered by the effect of linear expansion. To eliminate it, special lubricants and cooling systems were invented. That's how the world saw the world's first two-stroke internal combustion engine. Which forever changed humanity and set fat horses in motion.

Electricity was first discovered by the ancient Greek philosopher Thales. Rubbing amber against wool, he realized that the stone attracts small objects and generates an electric current between them. But let's look at a more modern creation of energy transmission. In the middle of the 17th century, Otto von Gerike invented the electrostatic generator. Stephen Gray's experiments showed that electricity could be transmitted up to 800 feet by a conductor (wet string) if contact with the ground was avoided and insulators were used; in 1791, Luigi Galvani announced his discovery of bioelectricity; 1800, Alessandro Volta created the first battery, the volt column. This new type of current source was much more reliable than the electrostatic generators used up to that time. In 1821, Michael Faraday invented the electric motor, and in 1827, Georg Ohm established mathematical laws describing currents in electric circuits. Faraday’s discovery of electromagnetic induction in 1831 paved the way for the production and use of electrical energy on a large scale, and the second half of the 19th century was a period of numerous inventions in electrical engineering.

Now we will talk about Internet networks. In 1957, the US Department of Defense first thought about reliable information transmission. Therefore, it was necessary to develop a computer network for this. Four US universities were tasked with implementing it. And in 1969, a talented group of scientists created a computer network called ARPANET (Advanced Research Projects Agency Network), which united these 4 universities. By 1973, the ARPANET network had become international. Organizations from Norway and Great Britain connected to the network with the help of a transatlantic telephone cable. By the end of the 1970s, they began actively working on the standardization of data protocols, which were successfully

standardized in 1982-1983. By early 1983, after the ARPANET network switched to the newly created TCP/IP network connection protocol, and got its known name ‘Internet’. Modern technologies are now heading in the direction of replacing human labor with AI, so we will talk about it

AI is revolutionizing industries such as healthcare, finance and autonomous systems, allowing machines to learn, adapt and perform tasks that would normally require human intelligence. Therefore, we can say that it is developing and learning every day to reduce our problems.

The next topic is renewable energy technologies and sustainable development. These include solar, wind and battery technologies, which are important for solving the problem of climate change and reducing dependence on fossil fuels. In the 21st century, this problem is very important for us, because there is not much time left before the end of fossil energy resources.

Also, I want to cover a bit of progress in genetic engineering (e.g. CRISPR and new genome editing techniques) molecular scissors can enable scientists to replace a damaged disease-causing gene with the correct copy, potentially transforming a cell into a healthy one. Currently, there are many tests in the world on the effectiveness of CRISPR/Cas9 for the treatment of blood diseases, skin diseases, muscular dystrophy, etc. Also, bioprinting of organs, artificial skin and improved prostheses can open new horizons in transplantology and disease treatment. In my opinion, the development of personalized medicine will also make it possible to select treatment based on the patient's genetic profile.

Another point that I feel is important to be raised is the space development, thus, I’d like to make an overview of commercial space flights, well-known companies such as SpaceX, Blue Origin, Virgin Galactic and others. In recent years more frequent flights into space and the transportation of satellites for research into new horizons have become more common. This, in turn, can accelerate space exploration by making trips to the orbit and the Moon regularly. Also, the development of projects for the study of Mars and the deeper regions of the Solar System bring humanity closer to life outside the Earth.

The development of artificial intelligence and autonomous systems is both beneficial but, at the same time, problem-causing in terms of privacy, security and responsibility. For example, autonomous decision-making algorithms can raise significant concerns about possible bias and discrimination. What's more, modern technologies that use huge amounts of data have risks for privacy. Every day we leave our digital footprints on social networks, apps, payment systems etc. Very often, the development of technology is associated with significant environmental challenges. For example, the production of electronics and new technologies such as quantum computers, which can be resource-intensive and produce toxic waste. The development of technologies such as blockchain leads to increased energy consumption, which harms the environment. The development of policies, ethical standards and legal restrictions is an important condition for ensuring the safe and responsible introduction of new technologies into society.

It can be concluded that technological breakthroughs are constantly changing society, creating new challenges and opportunities for human exploration. If we look to the future, new technologies give hope for development and progress in various fields - energy, health care, intelligence and space exploration. Despite the fact that the future of technological innovation has great prospects, it also requires careful consideration of ethical and moral considerations to ensure a sustainable, just and responsible development of society.

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ROBOTIC INTEGRATION IN OUR LIVES

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Robotics is one of the most important innovations of the present-day science and technology contributing much to the post-industrial society. Robotic systems have application in all sectors, healthcare, home automation and more, thus impacting the economic and social sectors. This topic is relevant as the projections of the global market indicate that the robotics industry will expand by 25% in the next decade.

This paper aims at analyzing the effects of robotics in different sectors of life, evaluating the current uses of robots, and considering possible future developments in the field of robotics.

Robotic systems are applied in many fields such as manufacturing industries, health, and farming. Information from the sources had been published not earlier than five years before the present researches were collected, and analytical and comparative analysis of the current level of robotic implementation in these fields was conducted.

There are lots of advantages of robotic systems. They have higher efficiency than human labor in conditions that need high accuracy and repetitive work. There is less demand for human resource as automation minimizes the demand for human employees. The current level of automation is about 85% at modern production factories and plants.

In healthcare, robotic systems, such as the Da Vinci surgical system, are used in operations that are minimally invasive and very precise. Such surgeries also reduce risks that are linked to complicated operations and give patients safer choices (Mayo Clinic, 2023).

In agriculture there are automation tools that help in the harvesting process, for instance, Agrobot. In industrial organizations, robots optimize production by rearranging the line of production, minimizing mistakes by 28%, and optimizing

operations.

Robotics is gradually changing the landscape of what can be accomplished using automation in various industries. It is for this reason that in the future there will be more innovations that will result in the integration of robots in many sectors of our lives. The application of artificial intelligence in robotics is expected to produce robotic systems that are more intelligent and self-sufficient to perform various tasks on their own. As the robots get smarter, they are expected to be used not only in monotonous operations but also in decision making processes including those in customer relations, or in health care. Besides, the trends of collaborative robots or cobots show that robots are safe to work with human beings, increasing productivity and at the same time reducing the risks of operations (World Robotics Report, 2023).

The integration of robotic solutions in different fields make industries more efficient and safer. This paper's review of academic and business literature shows that robotic technology delivers substantial benefits and creates new possibilities for the development of the society.

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ARTIFICIAL INTELLIGENCE: CURRENT USE AND FUTURE PERSPECTIVES

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Nowadays artificial intelligence has occupied a special place in everyday life.

Therefore, it's important to begin with defining the notion of artificial intelligence. According to Britannica, artificial intelligence (or it's common short variant AI) can be defined as "the special ability of a computer or computer-controlled robot to perform tasks that are commonly associated with the intellectual processes characteristic of humans, for instance the ability to reason." (Encyclopedia Britannica, 2024).

Just as anything in this world, AI develops every day and this development is happening at an unprecedented rate. From the moment when people all around the world used to use artificial intelligence just for some simple daily needs such as cooking, searching for information for school projects, finding stuff according to their preferences etc. to something more global. For example, NASA has been using AI during planning missions for their rovers, to detect anomalies or even to automate some time-consuming processes, for example, like program or projects reviews.

However, space is not the only field, where people developed practical solutions on implementing AI. For instance, healthcare, which is one of the most important branches for humanity, has not become an exception, and instead of standing aside, it also adapted to use AI. Currently hospitals use artificial intelligence to develop diagnostic tools and personalized treatment plans. A vivid example of AI's practical application is given by Forbs. An article presents an information about "a group at Mount Sinai who managed to use deep learning-based AI algorithms to predict the development of diseases with 94% accuracy, including cancers of liver, rectum, and prostate. Published cancer research, clinical trials, and drug development have provided a plethora of data proving that AI can help to review and then guide healthcare decision-making." (Forbs, 2024).

Financial industry also faced some changing after implementation of AI in banking system, some routine tasks were automated and that made it easier for both customers and bank-workers to cooperate. For example, it is the development of AI-powered chatbots for customer service, automated document processing for loan approvals, and algorithmic trading systems for financial markets.

Climate change has become one of the most terrifying problems for people around the globe. That's why several thought leaders in AI and machine learning believe that artificial intelligence could be the key to solve this problem.

Shown examples are just proving the statement that day in, day out the world changes with the development of artificial intelligence. There are some foresights that in the nearest future, when AI becomes more accurate, it could be used to solve more sophisticated issues, from any fields that are important for humanity.

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SMART TECHNOLOGIES IN SCIENCE

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The rapid development of smart technologies has had a significant positive impact on modern research results. The use of artificial intelligence, big data analytics, and machine learning has greatly improved the accuracy of research results

and their efficiency.

Essential to smart technology are artificial intelligence – technology that allows machines to perform tasks that previously required human intelligence; the Internet of Things – a network of connected devices that exchange and interact with data to automate tasks; and Big Data – large volumes of diverse data that are rapidly generated and processed for analysis and decision-making.

Smart technologies' history began in 1956 at a conference at Dartmouth College, when the concept of artificial intelligence was officially introduced. The main goal was to create machines capable of learning, making decisions and solving tasks that previously required human intelligence. After the first expert systems were created in the 1970s, intelligent technologies began to be actively used in science. Knowledge bases and logic have been used to solve complex problems in specific domains.

One of the oldest expert systems developed by Stanford University was MYCIN. It was written in Lisp as Edward Shortliffe's doctoral dissertation and supervised by Bruce Buchanan, Stanley Cohen, and others (Contributors to Wikimedia projects, 2004). One of the first expert systems developed by artificial intelligence researcher Edward Feigenbaum and geneticist Joshua Ruckberg in 1965, Dendral was designed to help organic chemistry researchers identify unknown molecules from the analysis of mass spectrometry data (Copeland, 2008).

In the 1990s, with the advent of more powerful computers and the development of the Internet, which increased the volume of data, major breakthroughs occurred in the application of smart technology. The introduction of big data to analyze large amounts of scientific information in real time was particularly important. This enabled scientists to make more accurate predictions, discover new patterns, and accelerate scientific research in many fields.

Since the early 2000s, with the development of deep learning and the Internet of Things, smart technologies have become more widely applied, providing new levels of automation and data analysis in science. Currently, the scientific fields most affected by smart technologies include medicine, ecology and climatology,

astronomy, biology, and genetics.

Smart technologies are actively transforming modern medicine, making it more precise and efficient. One of the main areas is the use of artificial intelligence for disease diagnostics. AI analyzes medical images (MRI, X-ray, CT) to quickly detect pathologies such as cancer, heart disease, or stroke, providing accuracy that sometimes surpasses human doctors (5 Examples of Smart Technology in Healthcare, n. d.). For example, AI helps to identify small tumors that may go unnoticed by the human eye, allowing treatment to begin in a timely manner.

The Internet of Things enables the installation of sensors for continuous monitoring of air, water, soil quality, and pollution levels. These devices collect data in real-time on harmful substance emissions, helping to promptly identify ecosystem-threatening changes. For example, IoT networks are used to measure air pollution in large cities and timely inform the population.

In the fields of biology and genetics, AI is helping scientists analyze large amounts of genetic data and identify patterns and correlations that were previously inaccessible (Mathur, H., Joshi, N., & Pandya, I., 2022). For example, AI algorithms are used to sequence the human genome, allowing the detection of genetic mutations associated with certain diseases, such as cancer or hereditary conditions. This enables the creation of personalized treatment methods based on the patient's individual genetic profile.

There are countless other examples of the application of smart technologies in various areas of science, but one thing is clear: smart technologies have become an integral part not only of everyday life but also of the scientific sphere. The future of science is closely tied to the continued development of smart technologies. Their application will help solve complex global problems, accelerate discoveries, and make science more accessible to humanity (Scope and Criteria, n. d.).

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USE OF ROBOTS FOR LIQUIDATION OF THE CONSEQUENCES OF THE ACCIDENT AT THE CHRONOBYL NPP

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Historical context

The 1986 Chornobyl nuclear power plant accident was not only a tragedy for Ukraine, but also for the whole world. It was a global event that changed the approach to crisis management in high radiation environments. Given the threat to the lives of the liquidators, robotic technology played a key role, although the technological capabilities at the time were very low. The example of the Chornobyl disaster response shows how extreme conditions stimulate the development of new technologies (Aguiar et al., 2024, pp. 1-28).

Several types of robotic systems were used during the Chornobyl accident response, differing in functionality and capabilities. «Lunokhod»: A lunar rover invented by the USSR and specially modified to collect radioactive waste, because before the modifications, it could not drive on the roof of the 4th rector due to

gravity. It had thick steel plates to protect it from radiation, and after 302 days of operation, the lunar rover covered 10.5 km at an average speed of 0.14 km/h. It was moving 18% of the time.

«Joker»: It was created in Germany at the request of the Soviet leadership to help in the aftermath of the Chernobyl disaster. It was designed as a high-tech robot capable of working in conditions of high radiation. The main task of Joker was to clear the roof of the fourth power unit from radioactive debris, where the radiation level exceeded the limits permissible for humans. Despite the seriousness of the approach, this robot did not work for long.

Mobile Robot Manipulator: This robot was one of the few machines that could be used effectively, thanks to its remote control. It cleaned the roof of the reactor, where radiation levels exceeded the capabilities of the human body.

But unfortunately, the use of robots was not so widespread at that time, so in the end they resorted to human power.

The main technical challenge for these robots was the resistance of electronic components to high levels of radiation. Most of them failed due to the inability of electronics to function in such conditions. For example, the Lunokhod system was capable of performing complex manoeuvres, but radiation quickly destroyed its main components (Aguiar et al., 2024, pp. 1-28). Another limitation was the level of autonomy of these robots, which required constant monitoring by operators, preventing full automation of work on the roof.

Impact on the development of robotics

Despite all the difficulties, the Chornobyl experience was a significant impetus for the development of robotics. First, it encouraged developers to create more radiation-resistant materials and electronic components that are now used in many industries. Secondly, the case demonstrated the importance of having robotic systems available for emergency response. This contributed to the development of robots that are now used not only in radiation contamination, but also in other extreme environments, such as space, deep-sea exploration, and man-made disaster sites.

Current achievements and prospects

The experience from the Chornobyl nuclear power plant has been used not only in the elimination of the consequences of severe disasters, but also in space technologies, which has helped to make new discoveries about our earth. Drones that can fly for long periods of time and collect accurate data are now used to monitor the radiation background in the Chornobyl zone. The latest robotic manipulators have powerful protective shells that allow them to work in high radiation conditions without the risk of failure. In addition, modern advances in artificial intelligence allow these robots to operate with minimal human intervention, which significantly increases their efficiency (Bankins & Formosa, 2023, pp. 1-16).

Conclusion.

The use of robots in the aftermath of the Chornobyl disaster was a landmark event that stimulated the development of the entire robotics industry. This experience not only demonstrated the capabilities of robots, but also highlighted the need for continuous improvement of technologies for work in extreme conditions. Today, robots working in hazardous areas are a direct result of technological progress initiated during the liquidation of the Chernobyl accident.

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THE CHANGING WORLD OF POWER GENERATION AND CONSUMPTION

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Energy affects all aspects of human life. It can't be overestimated. Energy is needed to power equipment, domestic appliances, manufacturing and many other. During the last hundred- and fifty-years power generation has started to develop extremely fast, although first attempts of using energy were made almost one and a half millenniums ago. Firstly, it was windmills and watermills. Then steam engine was invented. It caused the Industrial Revolution: human work was replaced by machines greatly. The discovery of electromagnetic induction by Michael Faraday in 1831 laid the foundation for the creation of generators and transformers which allowed the conversion of mechanical energy into electrical energy. In the early 19th century coal along with oil became the primary energy source used for steam engines and power plants.

In 1942 the group of scientists led by Enrico Fermi created the world's first nuclear reactor, opening new opportunities for power generation. Since the second half of the 20th century nuclear power plants have gained widespread popularity, and even now the importance of NPPs is growing quickly. It's all because of their total safety for the environment. According to the World Nuclear Association, in 2023 nuclear generators created a total of 2602 billion watt-hours of electricity. For instance, in 1977 it was nearly 500 billion watt-hours of electricity. Today in the developed countries decarbonization is becoming more popular. The reduction of coal usage in the energy sector is achieved not only through nuclear power plants but also through renewable energy sources. It is solar energy that is gained by solar panels, hydropower that is generated at hydroelectric power stations, wind energy

with turbines. According to the International Energy Agency the share of renewable energy sources in global electricity generation accounts for 29%.

Looking ahead, the energy sector is predicted to undergo profound changes. The International Energy Agency says that renewable energy sources could supply over 50 % of global electricity by 2030. The Paris Agreement limits greenhouse gas emissions by urging countries to take action in the fight against climate change and supporting commitments to achieve a better climate situation.

The industrial sector is the largest energy consumer, using about 54% of global consumption. The transport sector is the second consumer, using nearly 30% of total energy. The services sector and householding represent the remaining energy used.

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SMART TECHNOLOGIES IN SCIENCE AND ART

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Smart technology is a field that is developing incredibly fast and is becoming more and more influential not only in computer science, but also in such fields, as: art and science. By means of smart technologies, scientists can speed up and automate their research. In the field of art, smart technologies allow artists, musicians and creative individuals to express themselves in new ways. The study will demonstrate exactly what impact smart technologies have on these two areas.

The subject of this research is intelligent technologies, in particular, artificial intelligence and machine learning, and their role in science and art. Here, methods of systematic article review and comparative analysis have been used to investigate how

these technologies influence scientific research and artistic projects.

Applications of smart technologies in science are used in data analysis. Artificial intelligence plays an important role in medical research as it helps process huge amounts of data. It gives doctors possibility to identify new disease patterns and make significant discoveries in the field of medicine. In medical research, i.e., in the UK Biobank project, artificial intelligence analyzes vast amounts of medical records and genetic information. This makes it possible to open up new prospects for treatment.

Another innovative method is simulation. In the NASA's Earth Observing System project, artificial intelligence algorithms are used to model climate change and predict the consequences of global warming which allows to increase the accuracy of forecasts by 20%. It also helps scientists understand the future challenges associated with climate change better. This is an important step in understanding and predicting climate trends.

Speaking about automation, robotic systems in laboratories help to reduce errors and increase the accuracy of experiments. Thanks to the automation of processes, the results become more reliable and reproducible. Laboratories like High-Throughput Screening at pharmaceutical companies use robotic systems to automate experiments which helps increase the efficiency of research significantly and speed up the discovery of new medicines.

Smart technologies are also widely used in art. Virtual reality substantially transforms art, opening up new possibilities for experiments. This changes the traditional perception of creativity, designing new ways of interaction with art. The Night Cafe project transports viewers to a virtual reproduction of Van Gogh's famous painting, giving them the opportunity to explore the space in 3D. It creates a unique experience where art becomes more interactive.

Computer vision technologies help identify artistic styles, making it easier to explore the limitless world of art. Thanks to these technologies, it becomes easier to analyze and classify different works, opening new perspectives for research. The Artsy project uses artificial intelligence to analyze vast amounts of data about

artworks and artists. It helps artists understand what their audience likes and adapt to fickle tastes better. Installations with artificial intelligence allow viewers to interact with the art. This changes the traditional approach to its perception and makes the experience more exciting. The AI Portraits project uses artificial intelligence to analyze people's portraits and create new images in the style of classical artists. It allows viewers not only to contemplate artworks, but also actively interact with them, making the experience more interesting and unique.

Thus, the use of smart technologies, such as artificial intelligence and virtual reality, changes approaches in science and art. New methods of data analysis and modelling help improve the accuracy of scientific research, and in the arts, technology opens up new opportunities for interaction and creativity. These results highlight the importance of implementing smart technologies in various fields which may lead to new discoveries and ways of self-expression in the future.

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HOW ROBOTS HAVE COME TO HELP PEOPLE IN VARIOUS SPHERES OF LIFE

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The field of creating and improving robots has been developing rapidly in recent decades. They are gradually and confidently integrating into our lives.

Robots are created to facilitate or eliminate human labour in difficult and dangerous jobs. A well-known example is the liquidation of the Chornobyl accident, where robots were used to throw debris from the roof of the power unit, which saved many lives.

Another example is the development of robotics in the field of fruit harvesting. Apples and other hard fruits are easy to pick, but grapes are quite difficult because the berries themselves are very soft and easy to crush. However, Extend Robotics, together with engineers at Queen Mary University of London, are improving the robots' ability to do this. The researchers are implementing sensors that collect information about grape bunches and use AI to determine whether the grapes are ripe. If so, the robot carefully plucks the bunch of grapes without any loss (The Economist Newspaper, 2024).

Robots also work in places where humans cannot work physically, such as on Mars or in volcanic vents. The first Mars Pathfinder robot has been working on Mars since 1997. Since then, 6 robots have been working on that planet, which in turn help people explore the new planet (Marshall & Grossman, 2009).

Thus, people are rapidly developing robots and AI to control them so that in the future we can avoid working on dangerous and difficult tasks and reduce human losses.

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THE INTERNET BOOM OF THE 1990S: HOW THE WORLD WIDE WEB CHANGED THE WORLD

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Since its establishment in 1989, the World Wide Web has been considered as one of the most influential periods in modern history, changing fundamentally the way people communicate and receive information. The appropriate analysis of this topic allows us to understand and explore how the improvement of the World Wide Web led to the change of key areas of human activity and laid the fundamentals of the modern digital society.

The World Wide Web originated as a project at CERN (European Organization for Nuclear Research) which was directed by British scientist Tim Berners-Lee. The primary goal was to resolve the issue of inefficient search for data located on various computers at CERN. Berners-Lee created the concept of a “large hypertext database” with embedded links connecting different documents, allowing users to quickly navigate between information with a simple click of a mouse. All the key tools such as HTTP protocol, the first web browser, server and website were created by Tim and his team by December 1990 and were made publicly available in 1991. These actions allowed the web to flourish. It was one of the first important steps to overcome information isolation.

Principle of operation

The World Wide Web operates based on a client-server model, consisting of

numerous servers that provide hypermedia documents in response to requests from clients. Each element in this document may have links to other documents or parts of the document. These hypermedia documents are structured in a way that allows for a rich user experience, as users can interact with diverse media formats within a single document. The links within these documents are organized to ensure that every information resource on the global Internet has a unique address (URL), enabling documents to reference not only other documents on the same server but also those on different servers across the Internet. Moreover, web browsers serve as clients for additional Internet services, including FTP, Usenet and email, facilitating access to a wide range of functionalities. Thus, the tools of the World Wide Web are adaptable for multiple services, improving user accessibility and unifying diverse resources, which makes the WWW a fundamental component of the Internet.

Impact on Innovation and Technology development

By creating the foundation of open standards, the World Wide Web has helped create an ecosystem conducive to innovation. Its decentralized nature of the Web has enabled developers and creators to build on existing technologies, significant advances in the fields such as data analysis, artificial intelligence and cybersecurity. The Web`s HTTP protocol laid the foundation for secure transactions, leading to HTTPS by the late 1990s, which became crucial for protecting user data in e-commerce and online banking. Another notable innovation is the emergence of APIs (Application Programming Interfaces), which support seamless communication and data sharing between various software applications. APIs have revolutionized industries by permitting the integration of a range of platforms, resulting in services like social media logins and payment gateways.

Conclusion

The Internet Boom of the 1990s, driven by the rise of the World Wide Web, fundamentally transformed human interaction, commerce and technological innovation, laying the groundwork for today’s digital society. The Web’s open, decentralized structure enabled rapid advancements in secure data exchange, online transactions and application integration – tools such as HTTPS and APIs emerged as

essential features of the digital world. By unifying diverse resources and enabling global information access, the Web has become a pivotal platform for digital communication and development. In this way, the World Wide Web remains a cornerstone of the modern interconnected world.

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BREAKTHROUGHS IN ENERGY INDUSTRY

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Nowadays it is impossible to imagine our life without energy or electricity. Computers and smartphones have become an integral part of people routine or job; moreover, we don't even pay attention to something so ordinary for us as a light bulb or availability of mobile communication. All of these objects don't work by themselves, but require electrical energy.

How often do we consider where the electric current in a wall socket comes from? Let's be honest – not very often. We just know that there are NPPs, TPPs and HPPs and other types of power plants. Many people do not need additional information; because an average consumer isn't interested in Physics and technologies – it does not matter – what really matters is the result (i.e. the received resource). From this point of view, advanced scientists and those indifferent to energy issues are quite similar: both of them need to have a power supply for their devices. When many people need energy, availability decreases, leading to higher costs. Despite the pursuit of economy, humanity consumes more and more. Thus, the focus shifts to the sources of energy and their sustainability.

It is necessary to understand why renewable energy sources (not any others)

are so necessary in the context of current and future technological development. Initially, people managed to convert thermal energy into mechanical and later into electrical energy. This can be considered the first major breakthrough in this field. It seemed very convenient: you burn something as long as it burns, and you have electricity in your house. However, fuel has the unfortunate property of running out. The Earth isn't a bottomless reservoir of oil, natural gas, or coal. Thus, we have come to the point that we must look for an alternative to fossil and non-renewable fuels.

Energy does not simply appear or disappear; it changes from one form to another. The Law of Conservation of Energy cancels all hopes on inventing something fictional like a "perpetual engine". All energy sources including renewables are exhaustible and will require replacement over time; the only difference is the duration of their availability.

Energy is everywhere: in atoms, mechanical waves, photons, etc. The next scientific breakthrough is the utilization of the following three forms of energy to generate electricity:

- Mechanical (used in wind and hydroelectric power plants)
- Atomic
- Solar

These renewables, especially solar energy, can be considered "infinite" relative to human lifespan and the existence of civilization. However, there are other working types of energy sources. All the three sources mentioned above have disadvantages: reactions in nuclear reactors at NPPs can be dangerous, as evidenced by tragedies like Chernobyl; hydroelectric power stations and wind power plants are difficult to build and not feasible everywhere; the construction of solar power plants requires a very large land area, in addition, their energy production will be uneven due to changes in the length of daylight periods in different seasons. Summing up, we should search additional renewable options. The next third breakthrough shifts focus from physics and new methods of energy conversion back to fuel. Yeas, like that – burn something again. The development of chemistry made it possible to obtain some type of fuel from waste. When there is nothing left to burn, you could recycle garbage into fuel

(usually, in gas form, but not always). It allows us to continue to generate energy from combustion while reducing pollution; everyone wins from this.

It very beneficial if we can take energy from the environment (the second "breakthrough"), as Sun, wind, rivers and especially atoms will remain available for an incredibly long period, but it is much better when you can renew resources (the third "breakthrough") and replace exhausted ones with them. The first "breakthrough" (regarding fossil fuel) isn't related to renewables, although, it gives the reason for the emergence of the next two. We've known since school that microorganisms are among the most common life forms. Microbial fuel cells include them as components. Microbial fuel cell is a device that uses the byproducts and processes of bacteria's vital activity to obtain energy. It's like a "live battery" – the fourth "breakthrough". The advantages include: 1) it doesn't pollute environment, on the contrary, industrial waste can be used; 2) resourcefulness is easily restored: as some microbes die, new ones appear. Efficient designs are being developed, so this is not widely applied. But the beginning has been made and, possibly, in a few dozen years this technology will become as common as NPPs.

Regarding the fifth "breakthrough", it could be anything, but the tendency is the following: take something that is always available and won't end too quickly if you start mining it and you'll get a new renewable energy source. It could be extracting energy from sound waves or the Earth's magnetic field, you can fantasize, because renewables are really a promising topic.

All in all, energy is one of the most essential resources. Thanks to it, most of our technologies function, and our gadgets aren't just useless pieces of plastic with radio and electrical components. Since energy sources are not eternal, we must look for new renewables and, strive for further breakthroughs in this branch of science.

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PRE-LICENSING REVIEW OF NEW NUCLEAR POWER DESIGNS, WHAT IT MEANS FOR UKRAINE AND THE WORLD

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The pre-licensing review of novel nuclear power designations before licensing in Ukraine is one of the most important steps toward enhancing the energy independence of the country, at the same time answering global challenges on climate. Reviews regarding innovative technologies like Small Modular Reactors with the involvement of the best practices from countries such as Canada, the USA, and the UK will contribute to Ukraine's effort for safe and sustainable development of nuclear energy in the future under the framework of the IAEA safety standards.

Modernization of the energy system is urgent for Ukraine, with the need to ensure energy security and international commitments to reduce greenhouse gas emissions. In this respect, nuclear energy becomes a priority, considering planned measures regarding the implementation of Small Modular Reactors (SMRs), which have improved safety and operational features.

A pre-licensing review is a preliminary analysis of the projects of nuclear facilities before the official licensing application. This allows the early identification of potential safety, technical, and regulatory issues so that the subsequent licensing process may be optimized, and the possibility of delays may be reduced.

Countries with developed nuclear energy sectors, such as Canada, the USA, and the UK, apply pre-licensing reviews to new nuclear projects. For example, CNSC has put in place the Vendor Design Review – VDR – but this is a process for preliminary assessment of the reactor project. In the USA, the Nuclear Regulatory Commission carries out pre-licensing consultations with reactor developers to bring

forth any potential issues at an early stage.

The State Nuclear Regulatory Inspectorate of Ukraine (SNRIU) has announced the introduction of the pre-licensing assessment system, developed according to Canadian experience. Special focus will be put on Small Modular Reactors, which, as mentioned, are part of Ukraine's energy strategy. That will increase the effectiveness of the licensing process and ensure that projects are within modern safety standards.

So, the pre-licensing review of new nuclear energy projects is one of the tools to ensure safety and efficiency in the development of nuclear energy in Ukraine. International experience and compliance with IAEA standards will increase the potential for sustainable industry development and energy independence in the country.

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IMPACT OF AI DEVELOPMENT ON THE LABOUR MARKET

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Artificial intelligence is the terra incognita of our time, an issue that is being

actively researched in proportion to how AI is improving. Many people are worried that AI will become so advanced that it will take away their jobs. AI creates new opportunities and challenges for employers and employees.

AI helps automate routine tasks According to the McKinsey Global Institute, by 2030, up to 800 million jobs in the world could be automated, which will be about 30% of the total workforce (McKinsey, 2017, p. 2) There will be a need to retrain workers who may lose their jobs due to automation However, it is worth noting that not only artificial intelligence, but also robotics contribute to the development of automation

The introduction of AI also leads to a change in skills requirements Demand for technical skills, data analytics, and AI system management is growing According to a study by the World Economic Forum, by 2025, 85 million jobs may be replaced, but 97 million new ones will be created at the same time, requiring new skills (World Economic Forum, 2020, p. 5) This highlights the importance of education and continuous learning to adapt to new conditions.

An analysis of the history of the impact of technology on employment shows that the elasticity of demand is a key factor in determining whether new technologies, including AI, will lead to an increase or decrease in jobs in certain industries. Elastic demand means that a change in price or other factors significantly affects the number of consumers willing to buy a particular product or service. If the demand for products arising from the introduction of AI is sufficiently elastic, it can lead to the creation of new jobs, even in the face of rapid technological progress (Bessen, 2019, p. 14).

To sum up, AI is radically changing the labour market, creating both challenges and new opportunities. Collaboration between governments, businesses, and educational institutions is critical to ensure that workers are adapted to new requirements, which will ensure sustainable development in this new era of work.

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THE CHANGING WORLD OF POWER GENERATION AND CONSUMPTION

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The world of power generation and consumption is undergoing rapid transformation. With the rise of renewable energy sources like solar and wind, and advances in energy storage and grid technology, electricity production is shifting towards more sustainable and efficient methods, reshaping the future of energy consumption globally.

Electricity is of great importance both in human life and in ensuring sustainable economic development. In many countries, the energy sector of the economy is on the path of drastic changes and radical transformations. Processes of mergers, takeovers, changes in the management structure, the boundaries of the sphere of activity and the territorial one are taking place presence, forcing many former energy monopolies to use new value creation models. (Fedorchuk, p.155)

The modern world is experiencing an energy revolution. Energy sources such as coal, oil, natural gas, and uranium and graphite are giving way to renewable sources, which include solar, wind, hydro, and geothermal energy. (Evdokymova, 2207, p. 318) This global transition is a key step in the fight against climate change, the reduction of harmful greenhouse gas emissions, food shortages and the spread of radioactive contamination in some areas.

In addition to abandoning fossil fuels, energy storage also plays a significant role. So, it is necessary to think not only about how to replace the energy system with a safer one for the environment, but also how to properly store energy without losing

it. To replace the energy system of today requires more than one year, a lot of resources, technologies, as well as the human factor.

Renewable energy is able to provide sufficient production of heat and electricity for industry, households, the transport sector and agriculture. It will create new jobs for the manufacture and installation of equipment, installation and maintenance of solar systems, and conducting energy audits of buildings.

Today, "green" energy forces us to look at known sciences and technologies in a new way, which can lead to the emergence of new, completely unknown fields of knowledge. (Koval, 2019, p.54.)

I believe that in energy, an innovative path of development, is an objective necessity.

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ECOLOGICAL PROBLEMS OF WATER RESOURCES IN UKRAINE

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Water is one of the most important aspects of people's daily lives. Someone may think that all the advantages of water end with the fact that it is important for direct consumption, but in fact, the quality, purity and many other parameters of water are closely related to many fields, such as energy production, the food industry, the pharmaceutical industry and microelectronics. Therefore, the topic of this article is very relevant to the world in general and to Ukraine, particularly.

Water is used to cool steam at thermal and nuclear power plants (TPPs, NPPs). Thanks to this, corrosion and surface deposits are prevented, a high degree of mineralization is guaranteed, and the chemical composition is stable.

Food cleaning, product processing, and beverage production rely heavily on water acidity. Even small contaminants can affect the acidity and safety of food, so water must meet all standards for bacteria, viruses, essential metals, and chemicals (*Uses of Water in Food Production and Processing*, 2015).

Water used in the pharmaceutical industry is very pure and contains very few ions, bacteria or pyrogens. This type of water is distilled for liquid extraction, purification and injection.

As for microelectronics, ultrapure water (UPW) should be used in a limited-volume container for microchips and other electronic components. Chip degradation or other defects in electrical devices can be the result of the accumulation of microparticles from bad water purification.

Therefore, knowing and understanding the importance of water and its multiple usages, we can talk about the environmental aspect. Due to the war that has been continuing for ten years in Ukraine, the condition of water has been influenced by numerous factors, such as:

1) Pollution of water bodies with corpses and subsequent poisoning with

products associated with their decomposition.

2) Use of illegal and inhumane means of destruction by a terrorist country and/or deliberate poisoning of water bodies/rivers with harmful waste.

3) Undermining dams, which causes a complete disruption of the entire ecosystem that is tied to the river or water body (*Rapid Environmental Assessment of Kakhovka Dam Breach,* 2023).

Other aspects not associated with the war are poisoning rivers with waste that large enterprises throw out and throwing waste on the beaches, river banks, and other public places by the citizens.

International environmental organizations, such as WWF (World Wildlife Fund), emphasize the risk of long-term contamination that is expected to persist even after the conflict ends (*Ukraine needs a sustainable, climate and nature-positive reconstruction,* 2022). This includes damage to water treatment infrastructure and industrial facilities, leading to toxic discharges into water and the accumulation of pollutants in rivers and soils.

According to UN data (Zhovtonog, 2023), in the long term, Ukraine may focus on strategies to protect water resources, focusing on the modernization of water supply and sewerage lines, as well as on advanced integration of solutions management of water resources to avoid the impact of climate change and the consequences of war.

Thus, large-scale recovery will require substantial resources and a comprehensive approach to ensure the sustainable restoration of Ukraine's ecosystems.

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PROSPECTS OF ARTIFICIAL INTELLIGENCE

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Artificial intelligence is a highly developed form of technology with yet unknown capabilities. And if 10 years ago the rapid development of artificial intelligence was only in the forecasts, today it is already a reality.

The term “artificial intelligence” was first coined at a conference in Dartmouth (USA) in 1956.

Today, Ukraine has no legal definition of the term AI. The only regulatory document on AI regulation is the Concept of Artificial Intelligence Development in Ukraine.

We have the opportunity to observe the development of AI in the world. The current stage of AI development is based on the concept of open models. The advantage of open models over traditional ones is their flexibility, dynamism, and quick adaptation to any conditions and programs.

Our society relies on expanding the capabilities of machines and gradually replacing human resources with technology. Therefore, the ultimate goal of many tech giants is to create artificial general intelligence (AGI).

AGI promises to revolutionize many industries, from medicine to space exploration. New inventions will allow solving complex problems, optimize the consumption of material, labor, and time resources, and improve the quality of life of

mankind. At the same time, American billionaire and businessman Elon Musk believes that AI can lead to the “destruction of civilization” (2023).

“The Big Nine (three Chinese companies – Baidu, Alibaba, Tencent – and six American companies - Google, Microsoft, Amazon, Facebook, IBM, Apple) are at the forefront of this race.

Currently, there is an ongoing debate about the dangers that the development of AI may pose.

A report commissioned by the U.S. Department of State from Gladstone AI claims that “the development of advanced AI and AGI has the potential to destabilize global security in a way reminiscent of the emergence of nuclear weapons” (TIME, March 11, 2024).

Bill Gates believes that AI will bring positive changes – whether in medicine, education, or climate change (Bill Gates, March 21, 2023).

However, there are risks:

1. AI doesn’t always understand the context of a human query well, and the information received is not correct.

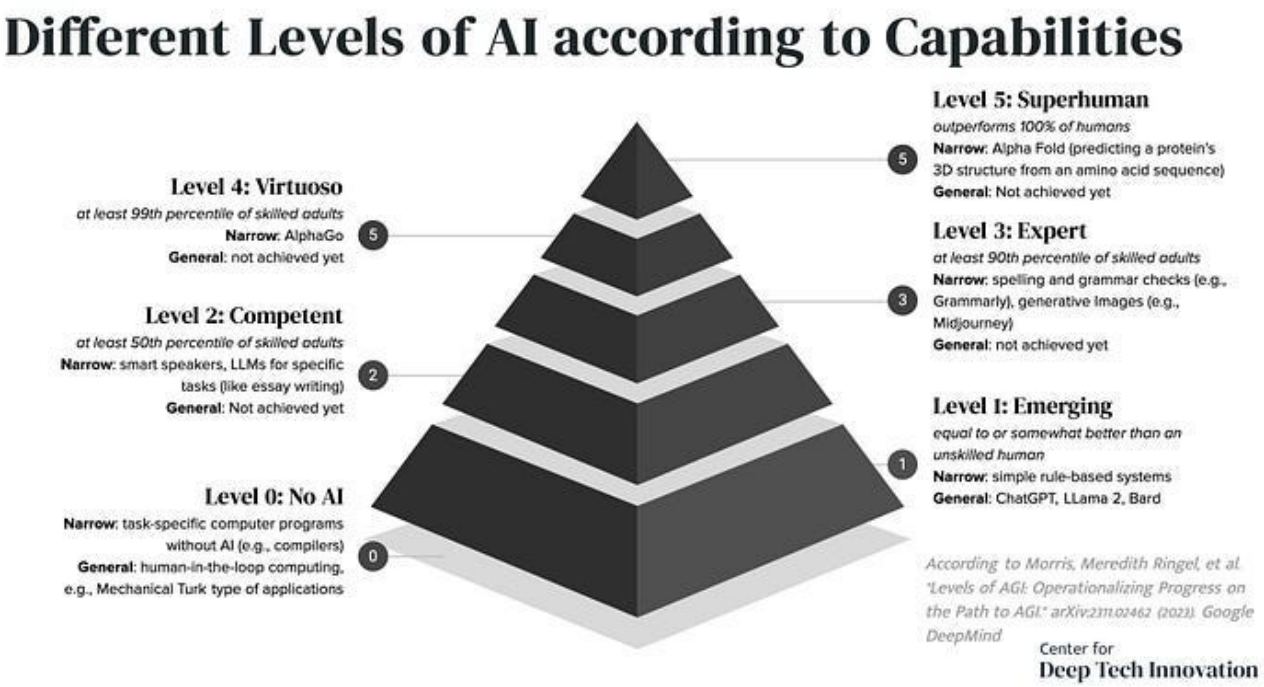
2. For certain reasons, AIs give incorrect answers to math problems.

3. AI can be used not only for good purposes but also for malicious ones.

4. There is a possibility that AI will get out of human control (Bill Gates, March 21, 2023).

The world's first regulatory act on AI is the European Union law (entered into force on August 01, 2024). It will regulate the operation of AI in the EU. The law contains strict rules for AI operation to eliminate any global dangers associated with this area.

Google DeepMind researchers have developed a 6-level structure for the clear classification of AGI:



Level 0 No AI (calculator software)

Level 1 Emerging - equal to or somewhat better than an unskilled human (ChatGPT)

Level 2 Competent - at least 50% of skilled adult abilities (specific tasks - essay writing)

Level 3 Expert - at least 90% of skilled adult abilities (spelling and grammar checking)

Level 4 Virtuoso - at least 99% of skilled adult abilities (logic games)

Level 5 Superhuman - outperforms 100% of humans

Today, AI is already widely used in everyday life:

- chatbots;

- medical software based on AI (eXtra Vision application used at the Romodanov Institute of Neurosurgery in Kyiv; dental procedures performed by a robot controlled by artificial intelligence);

- creation of artistic, musical, literary works;

- a robot taxi without a steering wheel and pedals, which will work on the basis of AI (Tesla);

- The Ministry of Economy of Ukraine signed a partnership agreement with the American company Palantir Technologies, which will use artificial intelligence to help demine Ukraine;

- The Ministry of Foreign Affairs of Ukraine has created a digital personality using AI technologies to provide official consultations for the media.

Investments in AI development are growing rapidly. Artificial intelligence can optimize business processes, eliminate some professions and promote the development of others, but it cannot change us, because technology is in the hands of people, not vice versa. So, don't expect revolutionary changes from AI. Revolutionary changes are made by people, and not always for the better.

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ROBOTIC SOLUTIONS INTEGRATION IN EVERYDAY LIFE: PROS AND CONS

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Nowadays, where technologies continue to constantly develop, the robotic integration in our lives is no longer something fantastic or unrealistic. Robots are now a common feature of our daily lives; they are changing industries and different processes due to their unsurpassed efficiency and accuracy.

Some scientists argue that by 2030 robotics is ready to revolutionize the way we live, work and interact with the outside world, and robots will become personal assistants, which simplify daily tasks, increase efficiency and overall quality of life.

Among the most popular industries which now actively integrate robotics are healthcare, agriculture, food and military.

- *Healthcare:* In the near future we will work closely with medical robots. The most popular will be robot surgeons, nurses, caretakers, disinfectants and medical specialists such as cardiologists, neurologists, ophthalmologist etc. The use of robotics enhances the precision and effectiveness of treatment.
- *Agriculture:* Robots are often used in this area for automation of sowing processes, harvesting, monitoring the state of fields, fertilization, etc.
- *Food industry:* Automated systems ensure fast and safe production, packaging and quality control of products. Robotic hands and machines are increasingly being employed in the food industry for tasks like packing, palletizing, picking and placing products, and even more complex tasks like cutting or intricate decorating cakes and pastries.
- *Military industry:* The military is able to reduce risks by employing robots in reconnaissance, mine clearance and dangerous operations.

So, what are the pros and cons of introducing robots into our lives? The pros include the following: the use of robots allows direct control in remote access, the

release of workers from hard work and work in harmful conditions, multitasking and efficiency of performing basic and auxiliary tasks and thanks to robots, a person can engage in more creative tasks and not waste time on routine work.

The cons include the possibility of unemployment because robots will replace all human labor, and the widespread use of robots may result in people becoming too dependent on technology and no matter how smart the robots are, they still will not replace the work done by a person, because not all robots can think logically, and most importantly, be guided by feelings when doing some tasks, etc.

In conclusion, we can point out that the integration of robots into our lives has its advantages and disadvantages. They improve the efficiency and accuracy of many processes, making life easier for us, but it is important to remember that technology should complement and not replace human labor, maintaining a balance between automation and the involvement of human skills.

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ACHIEVEMENTS IN TESLA MEGAPACK ENERGY

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The modern energy landscape is characterized by a shift towards renewable energy sources. One of the key elements of this transformation is efficient energy storage. Megapack technology, developed by Tesla, offers a state-of-the-art solution for storing large amounts of electricity. These theses are dedicated to a detailed analysis of the technical characteristics of Megapack, its principles of operation, and its potential application in various energy sectors.

The Tesla Megapack is an innovative energy-saving device designed to provide large-scale electricity accumulation and storage. The Megapack is a scalable solution that integrates with a variety of renewable and non-renewable energy sources, such as solar, wind, and hydroelectric power plants. Its goal is not only to balance energy use but also to help reduce carbon dioxide emissions, ensuring a stable and environmentally friendly energy system.

A single Tesla Megapack has a capacity of up to 3.9 megawatt-hours (MWh), allowing it to store significant amounts of energy. Thanks to their modular structure, these units can be combined into scalable networks, making it possible to create vast battery systems. For example, a system consisting of hundreds of Megapacks could provide power for large cities or industrial plants. A special feature of the Megapack is its ability to respond quickly to changes in the power grid, providing instant load balancing.

Each Megapack comes with a 15-year warranty, free from defects and with energy-saving assurances. Once a Megapack reaches the end of its useful life, Tesla states that it can be returned for recycling.

The Megapacks are pre-assembled, including "battery modules, bi-directional inverters, thermal management system, AC main switch, and controls."

Each Megapack requires minor annual maintenance and major maintenance

every ten years. Annual maintenance includes an inspection and cleaning, while ten-year maintenance involves replacing the pump and fan for the thermal management system and refilling the coolant.

The basic principle of the Tesla Megapack is to store energy during times of excess production (for example, when solar panels or wind turbines generate more energy than needed). Later, during peak loads or energy shortages, the Megapack can supply the stored electricity to the grid. This avoids overloads and stabilizes the grid. The key benefits include high efficiency, environmental friendliness, and cost savings, as the Megapack reduces the need for gas turbines and other traditional generators.

Tesla Megapack is already actively used in many countries worldwide, including Australia and the United States, where it helps reduce dependence on fossil fuels and stabilize energy supplies on a large scale. For example, a 100 MWh power station was successfully constructed in South Australia in 2017, which helped stabilize the energy grid. Another example is a station built in Texas in 2021 to stabilize the network in response to the disaster caused by three consecutive storms, which took nearly the entire state's power grid offline. The main practical use of Megapack is grid stabilization during peak loads. Additionally, this station has significantly reduced energy supply costs for small utility companies in Canada.

It stands to reason that this technology could take root in Ukraine, where many thermal power plants have been destroyed due to enemy shelling. Damaged power plants create a shortage of generating capacity during peak loads, such as in the morning or evening, when people come home from work and turn on appliances

masse.

By storing energy in these units, this shortfall can be compensated. The most rational use is in conjunction with solar or wind power plants.

However, although this technology has many advantages, such as the possibility of more efficient use of green technologies and the ability to accumulate energy for use at a convenient time, it also has some drawbacks, such as an increased risk of fire, the inability to extinguish these batteries with water, and a relatively short

battery life of about 10-20 years. It also requires constant maintenance to ensure reliable operation. Undoubtedly, with the development of energy storage technologies and a reduction in the cost of Megapack, its potential will increase significantly in the future.

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TECHNOLOGICAL BREAKTHROUGHS: THE PAST, PRESENT AND FUTURE

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The growth of human civilization is largely dependent on technological advancements, which progress everything from communications and culture to transportation and medical sphere. Once-scientific changes are now commonplace, and even more significant changes are anticipated in the future. Looking at significant historical discoveries we highlighted current accomplishments, trying to predict potential future developments.

Since the beginning of time, technological advancement has accompanied humankind. The Industrial Revolution, which changed methods of manufacturing and trade, began with the development of tools like the wheel, the steam engine, and electricity. Eventually, these technologies made it possible to create sophisticated businesses and transportation networks, which increased international trade and

cross-cultural flow of ideas. (Mokyr, 1990, p. 45).

The telephone, radio, and eventually the computer were among the innovations. That came about as the rate of advancement quickened over time. Each of these breakthroughs broadened and sped the flow of information, making communication easier. The current global information network was made possible by the 20th century's advancements in computer devices and the internet. Business and research were bolstered by this technical base, which increased human potential. (Basu et al., 2018, p. 220).

In the 21 centuries, the world will be in a new revolution, driven by the greatest evolution of mankind – the greatest genetic engineering, artificial intelligence, and quantum computer technologies. Nowadays, it seems that there is an over active application of artificial intelligence and machine learning in almost all spheres of industries, including medicine for the early detection and diagnosis of health issues as well as in the economy for forecasting activities. For example, today's algorithms enhance efficiency and lower costs in health care by making diagnoses more accurate, relying on medical imaging. (Goodfellow et al., 2016, p. 105).

Quantum computers are currently in the experimental phase, yet they have already shown they can tackle problems that traditional computing systems cannot. Their use has the potential to completely transform the industries of logistics, cryptography, and pharmaceuticals. Scientists believe that the prediction of intricate chemical interactions and the creation of more potent medications will be made possible by quantum computing. (Preskill, 2018, p. 43).

Biotechnology has also advanced significantly, especially in the areas of genetic editing techniques like CRISPR. These technologies create new possibilities in agriculture and medicine and allow more precise DNA editing. CRISPR is now being used to cure some genetic illnesses, and it has the potential to advance personalized medicine, in which each patient receives a customized course of treatment (Doudna & Charpentier, 2014, p. 823).

Future developments in technology could have an even bigger social influence. For example, nanotechnology may serve as the basis for novel approaches in the

fields of ecology, energy, and medicine. By penetrating the human body and delivering medications directly to the afflicted areas, nanobots may develop into miniature diagnosticians that eliminate the need for invasive operations. Nanomaterials can lower energy costs and increase battery efficiency in the energy sector, increasing access to "clean energy".

The switch to renewable energy sources is another encouraging avenue that may help fight climate change and drastically cut pollution. For example, new-generation solar panels and hydrogen fuel cells pave the way for reducing dependency on fossil fuels. Environmentally friendly technology has the potential to transform the economy and create new jobs and business opportunities.

Brain-computer interfaces also create new opportunities to enhance human-machine interaction and cognitive processes. By allowing people with impairments to interact with the world in new ways, interfaces that facilitate mental device control has the potential to revolutionize everyday life as well as healthcare. These technologies may also improve our comprehension of cognitive potential and increase the capacity of the human brain.

In conclusion, technological advancements bring about changes that affect how people live, think, and interact; they are not just new tools or gadgets. The modern world was made possible by historical accomplishments, but current developments open the door to even bigger breakthroughs down the road. Every new development, from nanotechnology and ecologically friendly solutions to artificial intelligence and quantum computing, moves humanity closer to a more productive and peaceful way of life.

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SMART TECHNOLOGIES IN SCIENCE AND ART

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The intersection of smart technologies – such as artificial intelligence (AI), augmented reality (AR), virtual reality (VR), and big data – with science and art is reshaping how we create, interact, and understand both fields. These technologies are enabling artists and scientists to explore new dimensions, pushing boundaries and fostering collaborations that were previously unimaginable.

This article explores how generative AI is pushing the boundaries of art and architecture. It highlights the work of artist Refik Anadol, who uses AI to create immersive art based on real-world data, such as climate changes or neurological data. Anadol's projects raise awareness of environmental and health issues while showcasing the power of AI in generating new forms of artistic expression (Zach Winn | MIT News, November 29, 2023).

Smart technologies are enabling deeper collaborations between scientists and artists. For example, artists are using scientific tools and data-driven techniques to visualize complex phenomena, like climate data. This blending of science and art helps make abstract concepts accessible to the general public. An example is data art, where real-world datasets are transformed into artistic representations, like the work of Refik Anadol, who uses AI and data to create immersive art (Darrell M. West and John R. Allen, April 24, 2018).

A prominent example of AI can be found in stock exchanges, where high-frequency trading by machines has replaced much of human decision-making. People

submit, buy and sell orders, and computers match them in the blink of an eye without human intervention. Machines can spot trading inefficiencies or market differentials on a very small scale and execute trades that make money according to investor instructions.

In conclusion it should be pointed out that the intersection of smart technologies with science and art offers unprecedented opportunities for innovation and collaboration. These advancements challenge our understanding of creativity and raise important ethical considerations. As we embrace these technologies, it is essential to foster dialogue among artists, scientists, and technologists to navigate their implications responsibly. By doing so, we can enhance our creative and scientific endeavors while ensuring that technology serves to enrich our society.

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POLYETHYLENE AS A CRUCIAL ELEMENT OF PLASTIC INDUSTRY

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Polyethylene, a cornerstone of the modern plastic industry, is a synthetic polymer with the chemical formula $(-CH_2-CH_2-)_n$. This seemingly simple structure

belies its extraordinary versatility, making it one of the most widely used plastics globally.

The journey of polyethylene began in the early 20th century. German chemists Hans von Pechmann and Johann Friedrich Wilhelm Adolf von Baeyer first synthesized polyethylene in 1898. However, it wasn't until the 1930s that researchers at Imperial Chemical Industries (ICI) in the UK developed a practical method for its large-scale production. This breakthrough involved heating ethylene gas (C_2H_4) to high temperatures and pressures in the presence of a catalyst, typically a transition metal compound like titanium (III) chloride.

Polyethylene is not a monolithic material; it exists in various forms, each with distinct properties tailored to specific applications. The most common types are:

- **Low-Density Polyethylene (LDPE):** Characterized by its flexibility, toughness, and resistance to moisture, LDPE is commonly used in plastic bags, food packaging films, and wire insulation.
- **Medium-Density Polyethylene (MDPE):** Offering a balance of strength and flexibility, MDPE is ideal for applications like plastic pipes, geomembranes, and agricultural films.
- **High-Density Polyethylene (HDPE):** Renowned for its high strength, rigidity, and resistance to chemicals, HDPE finds applications in a wide range of products, including bottles, containers, toys, and pipes.

Polyethylene's versatility is evident in its diverse applications: Packaging: From grocery bags to food containers, polyethylene is ubiquitous in the packaging industry. Its excellent barrier properties, flexibility, and durability make it a preferred choice for protecting products. Construction: Polyethylene pipes are widely used in plumbing and drainage systems due to their resistance to corrosion and ease of installation. Additionally, geomembranes made of polyethylene are employed in civil engineering projects for waterproofing and erosion control. Electronics: Polyethylene's excellent dielectric properties make it a valuable material in the electronics industry. It is used as an insulator in cables and as a component in various electronic devices. Medical Applications: Polyethylene’s biocompatibility and non-

toxicity make it suitable for medical devices like catheters, syringes, and surgical implants. Automotive Industry: Polyethylene is used in various automotive components, including fuel tanks, bumpers, and interior trim, due to its lightweight, durability, and recyclability.

One of the most significant advantages of polyethylene is its recyclability. HDPE, in particular, is easily recyclable, making it a sustainable choice for various applications. In fact, you can recycle HDPE at home by heating it in an oven to create plastic sheets that can be used to make boxes or extruded into rods for 3D printing.

As technology continues to advance, we can expect to see even more innovative applications of polyethylene. By understanding its properties, production processes, and environmental impact, we can make informed choices and contribute to a more sustainable future.

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THE RISKS AND DANGERS OF ARTIFICIAL INTELLIGENCE

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Artificial intelligence (AI) is perhaps one of the most amazing and even a little frightening achievements of recent years. We are already seeing how it penetrates different areas and begins to change our lives. And it seems that this is only the beginning. In medicine, for example, AI helps doctors make diagnoses faster and more accurately, find new drugs, and select treatments suitable for a particular patient. In finance, it catches fraudsters and helps companies better manage risks. And in factories, AI performs routine tasks, making work faster and cheaper. And yet, many people fear that automation will make some jobs disappear. For example,

workers at the factory, taxi drivers, cashiers, accountant, banker, etc. This is a serious issue because people will have to learn new skills to remain in demand.

Currently, AI is even trying itself in creativity – it writes texts, draws pictures, and composes music. This opens up new horizons for designers, musicians, and writers. Interestingly, AI can't so much replace people as complement them, helping with data analysis so that we have more time for important decisions and creativity.

However, this breakthrough technology has some downsides. Thus, the *purpose* of the article is to find out which threats AI possesses for humanity.

Firstly, AI learns from huge amounts of data, which in itself can be biased. This means that AI can not only adopt but also amplify mistakes or stereotypes that already exist. Another important issue is privacy. AI often works with personal data, and if it is used incorrectly, this can affect people's rights and freedoms (Caballar, 2024). To avoid data loss, always check the site for authenticity. Never give complete information about yourself.

And, of course, there is the possibility of creating a so-called "general" AI, which could not only carry out commands but also think flexibly, almost like a human. On the one hand, this sounds amazing, but on the other, it possesses a certain number of threats. If such AI becomes a reality, we will need to carefully consider how to work with it so as not to harm ourselves.

Taking everything into account, we can state that there are certain risks and dangers presented by AI that may cause further scientific progress and the emergence of new technologies that will allow controlling and regulating the application of artificial intelligence tools.

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GLOBAL WARMING: CAUSES, IMPACTS AND SOLUTIONS

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Global warming is an urgent issue of increasing concern to scientists, policy makers and the public. Global warming refers to the long-term increase in the average temperature of the Earth's climate system, caused primarily by the accumulation of greenhouse gases (GHGs) in the atmosphere. This phenomenon is exacerbated by human activities such as fossil fuel burning, deforestation and industrial processes that release large amounts of carbon dioxide (CO2), methane (CH4) and other heat-trapping gases.

Causes of global warming

The main cause of global warming is the increasing concentration of greenhouse gases in the atmosphere. The greenhouse effect refers to the way greenhouse gases prevent heat from escaping into space. The most important contributors to this effect are as follows:

Burning fossil fuels: burning coal, oil and natural gas for energy production and transportation is the world's largest source of CO2 emissions. As industrialization increases, especially in developing countries, energy demand increases and greenhouse gas emissions rise.

Deforestation: forests play an important role in absorbing atmospheric CO2. However, widespread deforestation, especially in tropical regions, is reducing the planet's capacity to reduce CO2. In addition, when trees are cut down or burned, the carbon stored in them is released into the atmosphere.

Agricultural practices: Methane, another powerful greenhouse gas, is produced in large quantities by livestock and rice farming. Nitrous oxide (N2O), especially from fertilizer use, also contributes to global warming.

Industrial activities: some industrial processes, such as cement production and chemical manufacturing, emit significant amounts of CO2 and other greenhouse

gases. Increases in global production and consumption have significantly increased these emissions.

Effects of global warming

The impacts of global warming are multifaceted and far-reaching, affecting not only the environment but also human societies around the world. Some of the most important impacts include:

Rising global temperatures: the average global temperature has increased by about 1.2°C since the late 19th century. This warming trend is expected to continue and is projected to rise by more than 2°C by the end of the century if current emission rates continue.

Melting glaciers: Glaciers in the polar regions of the world are melting at an unprecedented rate, contributing to rising sea levels. This not only threatens coastal areas with increased flooding, but also leads to the loss of critical habitats for species such as polar bears and seals.

Extreme weather: global warming is leading to an increase in the frequency and intensity of extreme weather events. Heat waves, droughts, hurricanes and heavy rainfall are becoming more common, destroying ecosystems, agriculture and human settlements.

Ocean acidification: When CO2 is absorbed by the ocean, it reacts with seawater to produce carbonic acid, lowering the pH of the water. This acidification has a particularly negative impact on marine organisms with calcium carbonate shells and skeletons, such as corals and shellfish.

Impact on biodiversity: Many plant and animal species are struggling to adapt to the rapidly changing climate. Species that cannot move to cooler regions or adapt quickly enough are in danger of extinction. This loss of biodiversity can disrupt entire ecosystems and lead to further environmental degradation.

Human health risks: Rising temperatures and extreme weather events pose direct risks to human health. For example, heat waves can cause heat stroke and cardiovascular disorders, especially in vulnerable groups such as the elderly. In addition, changing climate patterns are altering the spread of vector-borne diseases

such as malaria and dengue fever.

Reducing global warming

Addressing global warming requires both mitigation (reducing or avoiding greenhouse gas emissions) and adaptation (adapting to the inevitable impacts of climate change). Key strategies for mitigating global warming include:

Conversion to renewable energy: Replacing fossil fuels with renewable energy sources such as solar, wind and hydropower is one of the most effective ways to reduce greenhouse gas emissions. These energy sources produce energy with little or no emissions and are increasingly cost competitive.

Energy efficiency: improving energy efficiency in industry, transportation and housing can significantly reduce energy consumption and therefore emissions. Technologies such as energy-efficient appliances, LED lighting and electric vehicles are examples of solutions that reduce carbon emissions.

Carbon capture and storage (CCS): CCS technology captures CO2 emitted from industrial processes and stores it underground to prevent its release into the atmosphere. Although still under development, this technology can play an important role in achieving net zero emissions.

Afforestation and reforestation: afforestation and reforestation can reduce atmospheric CO2 Forests can act as natural carbon sinks and offset emissions from human activities by increasing forest cover.

International agreements and policies: Global cooperation is essential to tackle climate change: The 2015 Paris Agreement is an important international agreement that brings countries together to limit the global temperature rise to below 2°C. It encourages countries to set ambitious emission reduction targets and strengthen resilience to climate change.

Conclusion

Global warming is a formidable challenge that demands urgent and concerted action from governments, industries, and individuals alike. The scientific evidence is clear: human activities are driving climate change, and without immediate intervention, the consequences could be devastating for both the natural world and

human civilization. However, through technological innovation, policy changes, and collective global efforts, it is possible to mitigate the effects of global warming and build a sustainable future for generations to come.

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THE HISTORY OF COMPUTER INVENTION

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A computer is a universal device designed to process information. It receives data, processes it according to the specified rules, and produces the result in a form that is understandable to humans. The first computer in history is considered Blaise Pascal's calculating machine, invented in 1642. It was the first primitive calculator that helped to add and subtract. Pascal's invention was improved in 1671. The German mathematician Gustav Leibniz invented an arithmetic calculator that performed four actions instead of two (Хто винайшов комп'ютер?, 2020).

The English mathematician Charles Babbage developed a device that not only performed arithmetic, but also printed the results immediately. In 1832, a tenfold smaller model was built from two thousand brass parts, weighing three tons, but capable of performing arithmetic operations to the sixth decimal place and calculating second-order derivatives. This computer became the prototype of modern computers; it was called a differential machine. Mathematician and mechanic P. L. Chebyshov created the summing machine with continuous transmission of tens. This device

automated all arithmetic operations (Поповський, 2024).

At the end of the 19th century, the United States conducted another census. To process the results, a Herman Hollerith tabulator, a device for processing punch cards, was used. The era of these primitive and ancient computers is interrupted by the first computers (electronic computers), which began to be created in the 1930s. One of the main disadvantages of tube computers was the lamps themselves. There were about 15-30 thousand of them in one device (Хто винайшов комп'ютер?, 2020).

At the end of 1943, the English special-purpose computer Colossus was launched. The machine worked on deciphering the secret codes of Nazi Germany. In 1944, Konrad Zuse developed an even faster Z4 computer. 1946 was the year of creation the first universal electronic digital computer ENIAC. In 1950, under the leadership of Academician S.O. Lebediev, the first computer in continental Europe, the MEOM, was created in Kyiv (Малиновський, 2012). In 1959, the Americans Jack St. Clair Kilby and Robert N. Noyce independently invented the integrated circuit, a set of thousands of transistors placed on a single silicon crystal inside a chip (Малиновський, 2012). In the 1960s, the transistor was invented, the first semiconductor to replace the electronic tube. The size of computers was significantly reduced, and their memory was several tens of thousands of words. The invention of the transistor contributed to a surge in the development of computers (Хто винайшов комп'ютер?, 2020). In 1965, the first minicomputer PDP-8 was released, which was the size of a refrigerator and cost 20 thousand US dollars. The PDP-8 was the first computer of the DEC PDP series to be mass-produced. In 1971, scientists from Federico Faggini's group working for Intel created the first single-chip microprocessor Intel 4004 (4-bit data bit), which was used in microcalculators. In 1974, Micro Instrumentation and Telemetry Systems (MITS) developed the first microcomputer, the Altair 8800, based on the Intel 8080 8-bit microprocessor. This computer became the first commercially successful personal computer. In the 1970s, computers finally became personal and affordable. This became possible because in 1972 an 8-bit microprocessor was created and used in computers (Історія появи

комп'ютерів, 2024). The Apple II is one of the first personal computers released by Apple in 1977. It was revolutionary for its capabilities, including color graphics and sound support (Apple II, 2023). In August 1981, a new computer called the IBM PC, officially shown to the public, quickly gained great popularity among users (Історія появи комп'ютерів, 2024). In 1992, one of the first laptops in the ThinkPad series, the IBM ThinkPad 700C, was introduced. It was equipped with an IBM 486 SLC processor and 4 MB of RAM. It came with a 120 MB hard disk (ThinkPad, 2023).

Since the late 1960s to the late 1970s, the history of the computer belongs to the era of integrated circuits. Back then, the computer came close to the PC we have today. In the second half of the 1970s, creating a computer that was affordable to everyone was no longer a problem. Two students, Steven Jobs and Steve Wozniak, an American with Ukrainian roots, created the Homebrew Computer Club in their garage, which would later become Apple Computer. It was the first computer aimed at ordinary consumers. You did not have to assemble a PC yourself; it was sold ready to use. The idea of a personal computer became super successful, and the product became popular. (Хто винайшов комп'ютер?, 2020).

Thus, the achievements of technical sciences are the basis of scientific and technological progress, a necessary condition for social progress. Computers are one of the most significant achievements of human thought, the impact of which on the development of scientific and technological progress can hardly be overestimated. The fields of computer application are constantly expanding. The history of computer development is still waiting for new inventions (Коли виник перший комп'ютер, 2017).

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PROSPECTS FOR ARTIFICIAL INTELLIGENCE

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Although the term “artificial intelligence” has recently started to gain its popularity, the history of its creation dates back to the last century. Artificial intelligence of those years could play chess and solve mathematical problems. The term itself appeared in 1956 (James Moor, 2006), and this event is considered to be the beginning of the development of this industry. Over the years, developers faced difficulties as artificial intelligence could not perform creative tasks, but in the 1980s (Palo Alto, 1981) expert machines appeared that somehow imitated human intelligence. And only in 2010 (Juyang Weng, 2015) a real prototype appeared, thanks to the development of neural networks and deep learning

Nowadays, the increasing abilities of artificial intelligence may produce a frightening effect on people. There is no one who has not heard of it, it is a really fascinating topic that we are going to discuss in this article. Anyone can go online and check how artificial intelligence works by himself. Currently, the most popular is ChatGPT that has started to be actively used by programmers to write their tasks. It will make some people panic about the future of this profession. But if you look at

the statistics and talk to each programmer about their experience with it, you can conclude that their productivity has fallen. ChatGPT can solve basic tasks, but it does not provide a complete picture of the application. Moreover, its code looks unclear and incoherent in some points, and you need to understand its code which takes time. Therefore, it is only suitable for solving routine basic tasks that a robot can actually perform. But it is definitely not suitable for more serious work (Francesco Filippucci, Peter Gal, Cecilia Jona-Lasinio, Alvaro Leandro, Giuseppe Nicoletti, 2024).

Therefore, the experience of using this technology directly by programmers is mediocre. However, artificial intelligence can be used in various fields. That is why it is called artificial intelligence, because it seems to understand something and can answer anything. This is what scares people, they start to think about what will happen next and whether it is possible for it to realize its life as a task performer, or whether it can become a personality? I am going to answer “no”. It is just a name “artificial intelligence”, in fact, it is just a code that has learnt from the same code and database that we, humans, have created! It has no idea who it is, it does not even have a paradigm of thinking. It is just knowledge based that humans have created. Because of this name, “artificial intelligence”, people label it with their own minds. But it is not logical, a person is a person, they have their own personality, which is not the case with a program. As we have not seen any other personally developed intelligence at our level, we cannot imagine anything other than what we have in our heads now.

What can we say about understanding another paradigm of thinking and applying the same labels to artificial intelligence that our minds have? When we cannot understand ourselves, for example, another culture, country, and entire mentality. This is all abstract for each of us.

We all need to understand that artificial intelligence is just a knowledge base that performs a trained human action (Darrell M. West, John R. Allen, 2018). And that is why he will never become a personality, unless of course he is programmed to do so. It is because it is taught by a human that it will never be able to change, it will only be an example of intelligence and its illusion. Even if it is developed to the level

of solving real professional problems, what guarantees are there for the correct operation of this solution? For example, an artificial intelligence of a doctor will be created that really understands its profession and how it works. But there was a small nuance in training this model of a doctor: the programmer who was doing it was a racist. He made this intelligence so that all African-Americans receive contraindicated medications. This will be noticed quickly, but still, someone can suffer from it. Or, for example, an artificial intelligence judge, where you can come up with the idea that if the name of the offender begins with "A" and the offense ends with "A", for example, then such a defendant is released without punishment. You can go on forever and really come up with bad things that will be difficult to notice. That is why artificial intelligence in such relevant professions is by no means unrealistic to see.

In conclusion, I would like to say that artificial intelligence is just a tool to help make people's lives easier, and it does not always have the competence to do so. We must understand that there is nothing wrong with it, it is a program trained by ourselves! We are waiting for the development of artificial intelligence as a tool, not an omnipotent one, so it has zero chance of replacing humans!

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PROSPECTS OF ARTIFICIAL INTELLIGENCE

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AI in Healthcare

The healthcare sector is one of the most promising fields for AI applications. Advanced AI algorithms have demonstrated unparalleled capabilities in analyzing vast amounts of medical data, ranging from patient records to complex imaging studies. For instance, AI can enhance diagnostic precision, reducing human error and enabling early detection of diseases that might otherwise be overlooked. Moreover, AI-driven systems can suggest personalized treatment plans based on a patient's unique genetic makeup and health history, potentially leading to more effective and less invasive medical interventions (Smith, 2020, p. 150).

Autonomous Vehicles

Transportation, another cornerstone of modern society, is on the brink of a revolution driven by AI. Autonomous vehicles, equipped with sophisticated AI systems, are poised to transform our daily commute. These vehicles can navigate complex urban environments, make split-second decisions to avoid accidents, and optimize fuel consumption, thereby reducing environmental impact. The integration of AI in transportation infrastructure promises not only to enhance safety and efficiency but also to redefine our relationship with mobility (Brown, 2021, p. 230).

Challenges and Risks

However, the proliferation of AI technology is not without its challenges. The same attributes that make AI powerful also pose significant risks. Privacy concerns are paramount as AI systems often require access to vast amounts of personal data. Additionally, ethical considerations must be addressed, particularly regarding the potential for bias in AI algorithms and the accountability for decisions made by AI systems. It is crucial for policymakers, technologists, and society at large to engage in an ongoing dialogue about these issues to ensure that the benefits of AI are realized without compromising ethical standards (Jones, 2019, p. 75).

Conclusion

In conclusion, the prospects of artificial intelligence are vast and varied, offering unprecedented opportunities for innovation and improvement across multiple domains. As we stand on the cusp of this technological frontier, it is imperative that we approach its development with both enthusiasm and caution. Through responsible stewardship, AI can be harnessed to address some of the most pressing challenges of our time, paving the way for a brighter and more efficient future.

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ROBOTIC INTEGRATION IN OUR LIVES

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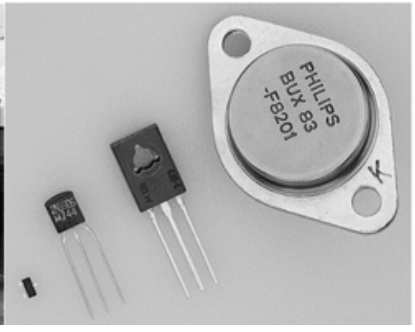
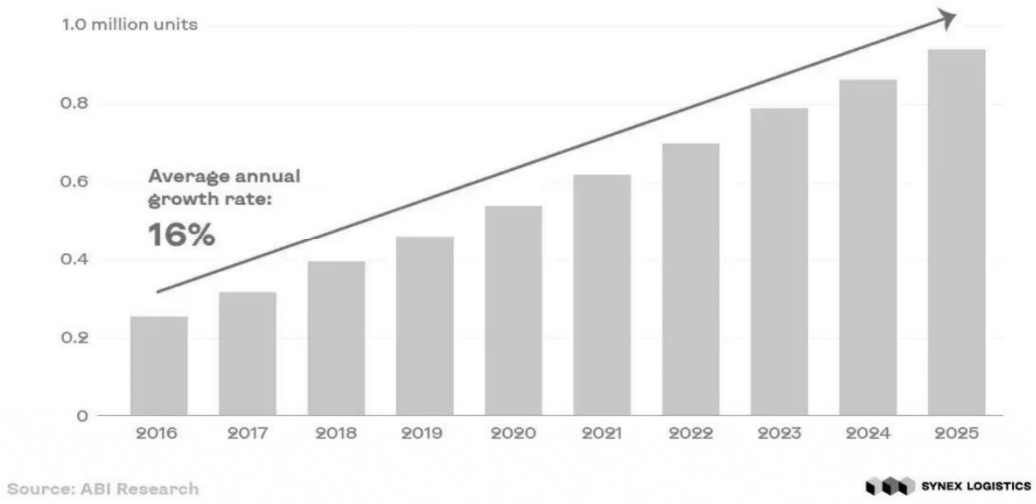
Nowadays robots and automated systems are closely integrated into every sphere of our lives: from the most primitive (cooking, cleaning, laundry) to much more complex ones that require extreme precision in actions (development of other automated systems, electronic devices, surgical operations).

Since ancient times, people have been thinking about ways to facilitate and optimise their work process, and manual labor has been gradually replaced by mechanical labor: grain was turned into flour by a windmill, and books became more accessible after the printing press's creation. Mechanical clocks made it possible to keep track of time accurately. Although it is difficult to identify these mechanisms as robots as they are currently understood, they can rightly be called the ancestors of modern robotic systems. Only after World War II did the trend towards the development of robotics and cybernetics gained momentum.

The second half of the twentieth century discovered: The first computers, which occupied large amounts of space, now look like modern PCs/laptops that occupy a small area of your workplace; the discovery of the transistor marked the transition of electronic devices from the vacuum tube era to the solid-state electronics era, which elements were smaller, lighter in weight, consumed less power and were more efficient and reliable than cathode ray tubes; manipulators, which are associated with the machine-building industry but can also reproduce the work of human limbs, etc.



Since a short time has passed these discoveries, have gone further. Every year, the number of transistors in integrated circuits (the basis of electronics) increases many times over, the computing power of computers increases accordingly, and thus the number, complexity, and speed of tasks increase exponentially. The Boston Consulting Group predicts that the share of robot tasks will increase from 8% today to 26% by 2025.



Today robots are directly or indirectly involved in all areas of our activity: production manipulators, couriers, dishwashers, demining robots, agricultural robots, indoor robots, medical robots, military robots, etc.

Despite the obvious benefits (freeing people from hard/hazardous labor, multitasking, efficiency of task performance, etc.), there is still a feeling of fear of being replaced by a technocratic culture.

As the classics used to say, ‘fear has big eyes’: modern robotic systems are at the stage of development when they are capable of making mistakes in the process of performing a task, despite their constant development, unlike a human being who can work efficiently for 8-12 hours a day; the main advantages of humanity are emotionality, empathy, improvisation and creativity, which robots have not yet adopted and are unlikely to adopt in the near future; do not forget that robots perform a clearly defined task, although it may carry a completely different context that the machine is unable to understand to the extent of the limitations inherent in its software.

In conclusion, you should not be afraid of tomorrow and a soulless machine will deprive you of your job, but to remain in demand, you need to work on yourself - develop soft-skills, skills in working with robotic systems and artificial intelligence in order to understand the algorithm of its work and be able to directly influence and control it.

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PROSPECTS OF ARTIFICIAL INTELLIGENCE

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Artificial intelligence (AI) is a relatively recent phenomenon in such form in which we are used to seeing it. However, to discuss its prospects we need to look back in time. The foundations of AI were laid in 1956 by John McCarthy. Every day AI becomes 'smarter' as it improves and processes more and more information. People use it in various fields to facilitate their work, and this is the background of 'theories' about the uprising of machines and other nonsense. However, if we dig deeper, we can see that AI cannot think in the same style as humans. It can solve a problem based on the information it has, but once the problem is solved, it will not do anything, unlike a human. However, the AI's 'father' wanted to give it the ability to 'think', so he improved it and conducted an experiment: a person would enter a room and talk to a psychologist, the psychologist was either a person or an AI, and the participant of the experiment had to determine with whom he was talking to. The experiment was not successful, so it was stopped in 1978. D. Maccari concluded that artificial intelligence needs 1.7 Einsteins, two Maxwells, five Faradays, and funding equivalent to 0.3 of the "Manhattan Project" to succeed. Although AI can copy the style of human conversation today, it does so only when a command is given. In 2024

Nobel Prize-winning physicist Jeffrey Hinton expressed the idea that the development of AI could lead to serious consequences. But AI is a great tool, just like fire, gunpowder or dynamite, and we shouldn't worry about whether the tool is dangerous or not. We have to think about who uses it, but that's a completely different story...

Today AI has already achieved breakthroughs in many areas. In the future, it can become a great assistant, thanks to which we will be able to get rid of the 'human factor' when measuring some data, and during operations we will be sure that it will not make a mistake by accident. Large-scale production facilities already mechanise the production of nanoscale parts: boards, processors, and with the help of AI all this can become more efficient. Therefore, AI has every chance of becoming a tool that will help people do hard work in various fields, giving them more time to enjoy life, but whether it will be so depends on people themselves and how they will use the 'assistant'.

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ARTIFICIAL INTELLIGENCE IN EDUCATION

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Artificial intelligence (AI) is rapidly finding practical applications across an abundance of business areas, with educational assessment and tutoring, grading, and student performance estimation is no exception. Over the last decade, a number of intelligent tutoring systems have emerged based on the idea that AI must not only automate assessment but also provide feedback, repetition opportunities, and well-

optimized individual curricula.

Personalized Learning: AI-based educational platforms provide tailored learning experiences by assessing student progress and making necessary material modifications. It means that each student can learn at their own pace and receive feedback that is specifically customized to them.

Luckin et al. states that adaptive learning systems analyze student interactions with the material and adjust the presentation to suit the learner's needs. (Luckin et al, 2016)

AI makes fast assignment grading. It concerns such subjects as science and math where answers are more objective. Thanks to advancements in natural language processing, artificial intelligence can already score written assignments. This offers the possibility of scaling examinations in areas that need subjective grading (Baker & Smith, 2019).

Thanks to AI traits such as text-to-speech and speech-to-text technologies, students with disabilities may now access education more readily. Besides, by translating educational resources into various languages, Holmes et al. (2019) declared that AI enhances inclusivity by breaking language barriers and providing equal learning possibilities. Large-scale student performance data may be analyzed by AI-powered predictive analytics to determine which pupils may have issues or require further help. This predictive capacity, according to Zawacki-Richter et al. (2019), allows teachers to interfere early, improving student storage and success rates. Despite these achievements, concerns over data privacy and the need for teacher's preparation remain regarding AI in education. Selwyn pointed out "the role of the teacher remains central, with AI being a tool to increase rather than replace traditional teaching methods" (Selwyn, 2019).

In summary, AI has the power to change education by pushing its effectiveness, accessibility, and customization. AI use has to be moderated with human's supervision to ensure that it increases and supports education rather than decreases it.

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GREEN TRANSITION THROUGH THE ENERGY SAVING TECHNOLOGIES

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Many people are convinced that our current lifestyle is exerting an extremely harmful and detrimental effect on the environment. Pollution of the ocean, land, and air with polymeric gases, produced by burning fossil fuels, is creating a harmful 'greenhouse effect' and ozone hole. Actions of humankind damage the environment

and deplete mineral resources.

In my opinion, however, Earth can still have a chance of salvation. Today it is possible, for example, to reduce the energy costs for heating by 60% of existing costs. At least, such goals are set by European states, and very quickly it becomes a reality.

Green energy requires both an increase in the share of renewable energy generation and a reduction in total energy consumption. The process of reducing energy consumption began in Europe in the early 2000's and is now accelerating significantly due to rising energy prices and the possibility of gas shortages in Europe. This problem is solved by energy-saving technologies, among which the following ones should be mentioned:

1. **Solar energy**: The Sun is an extremely powerful energy source, and sunlight is by far the largest source of energy received by Earth; thus, solar energy has long been used directly as a source of thermal energy. Since the beginning of the 20th century, technological advances have increased the applications of the sun's thermal energy, opening the door for solar power generation. Thus, energy experts have the prerequisite to claim that by 2030 solar energy is expected to power 13% of the world.
2. **LED lights**: Reducing your lighting energy consumption by 50-60% can be achieved with the help of LED lighting. The key benefits of LED lights include minimal power, longer lifespan, and instant illumination when switched on. Moreover, they fit perfectly into the existing sockets, which allows to minimize the need for switching.
3. **Heat pumps**: Being an alternative way of heating your premises, heat pumps provide both heating and cooling. This is particularly useful if we take into account that heating is not only a major part of the running costs of industrial and commercial facilities but also a major source of carbon dioxide emissions.
4. **Wind power**: Today, wind energy undeniably is the fastest-growing renewable energy source, and, thus, it plays a crucial role when it comes to achieving a zero-carbon future.

5. **Battery storage solutions** are battery units installed on-site allowing to store and discharge electricity at specific times. These units do not depend on the national grid and, consequently, provide backup power and supply security even at peak demand periods.

All things considered; we can summarise that energy saving technologies are urgent at the moment. Annually, their importance and necessity will only increase. High temperatures, droughts, wildfires, floods, problems of fresh water availability - all of these are the results of global warming. Using energy-saving technologies can help to prevent it and save the Earth.

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GLOBAL WARMING

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Rising global temperatures and climate change pose a serious threat to the future of the planet. In this connection, there is a need to develop new approaches to reducing carbon emissions in the energy sector. In recent years, renewable energy sources such as solar panels, wind turbines and biofuels have become popular options for new power plants. However, despite all their advantages, these technologies face a number of difficulties, including the inability to provide reliable baseload power,

which is necessary for an uninterrupted supply of electricity. To provide stable energy support, large plants that can operate continuously are needed, including coal, gas and nuclear power plants. The first two options certainly do not provide carbon-free energy, but nuclear power can be an alternative that will significantly reduce the carbon footprint. Thanks to technological progress and improved safety, nuclear power plants can become a key element in the fight against climate change, complementing renewable energy sources to meet targets for reducing greenhouse gas emissions. Thus, modern challenges related to global warming open up new opportunities for the development of energy solutions that combine environmental safety and reliability of energy supply.

Rising global temperatures and climate change demand immediate and innovative approaches to reduce carbon emissions in the energy sector. While renewable energy sources such as solar, wind, and biofuels show promise, their limitations in providing consistent baseload power underscore the need for alternative solutions. Nuclear energy, with its low carbon emissions and advancements in safety technology, offers a viable path forward. Integrating nuclear power alongside renewables could be essential in achieving both the reliability of energy supply and the ambitious targets for greenhouse gas reduction, addressing the dual challenges of sustainability and climate resilience.

The alarming rise in global temperatures and the escalating impacts of climate change emphasize the urgent need for innovative, sustainable energy strategies to reduce carbon emissions in the energy sector. While renewable energy sources, such as solar panels, wind turbines, and biofuels, have gained traction as cleaner alternatives to fossil fuels, their intermittent nature presents limitations for providing a consistent baseload power supply, which is crucial for uninterrupted electricity generation. This shortcoming highlights the importance of diversifying energy sources to achieve a balance between environmental responsibility and reliability.

Traditional energy sources like coal and natural gas plants offer stability but contribute significantly to greenhouse gas emissions, exacerbating climate issues. In contrast, nuclear energy, due to its high energy density and zero carbon emissions

during operation, emerges as a promising solution capable of bridging the gap between renewables and reliable power generation. Advances in nuclear technology, including enhanced safety measures, waste management solutions, and even the potential of small modular reactors (SMRs), bolster its position as a viable complement to renewable sources in the fight against climate change.

The integration of nuclear energy alongside renewables not only enhances energy security by providing stable baseload power but also supports the ambitious global goals for reducing greenhouse gases. Achieving these goals requires a combined approach that leverages the unique strengths of each energy source - renewables for their minimal environmental impact and nuclear for its stability and carbon-free energy production. Therefore, as we confront the pressing issues of global warming, the development and deployment of a diversified energy portfolio that combines renewable energy sources with advanced nuclear technology represent a crucial step toward a sustainable, resilient, and low-carbon future.

The dramatic rise in global temperatures and the intensifying effects of climate change underscore the urgent need for a paradigm shift in the energy sector, aimed at significantly reducing carbon emissions. Renewable energy sources, such as solar, wind, and biofuels, have emerged as critical players in this transition. However, despite their environmental benefits, their intermittent production capacity raises concerns about their ability to provide a stable, reliable energy supply, especially under high demand.

To address these limitations, it is essential to explore alternative energy sources that can support renewables by offering consistent baseload power. Nuclear energy, with its low greenhouse gas emissions and significant technological advancements in recent decades, presents itself as a viable solution. The potential of nuclear power lies in its capacity to operate continuously, providing a steady power output, which is crucial to meeting the energy needs of modern societies without compromising environmental targets.

The integration of nuclear power alongside renewable sources could lead to a robust, sustainable energy mix that combines environmental responsibility with

energy security. With advances such as improved reactor safety, innovations in waste recycling, and the development of next-generation nuclear technologies, nuclear power is increasingly seen as a key player in the transition toward a carbon-neutral future. By adopting a comprehensive approach that includes both renewables and nuclear power, the energy sector can effectively balance sustainability, reliability, and scalability, paving the way for a resilient and climate-friendly energy infrastructure.

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ALTERNATIVE ENERGY REQUIRES THE MOST DEVELOPMENT TO THE ECONOMIC EFFECT OF TOURISM CONCEPTS: ANALYZING THE SUCCESS OF INNOVATIONS

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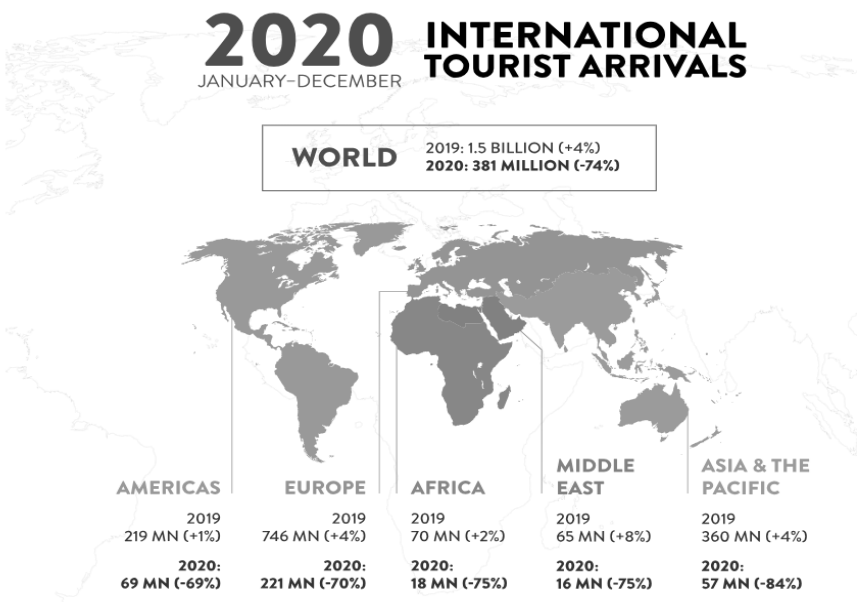


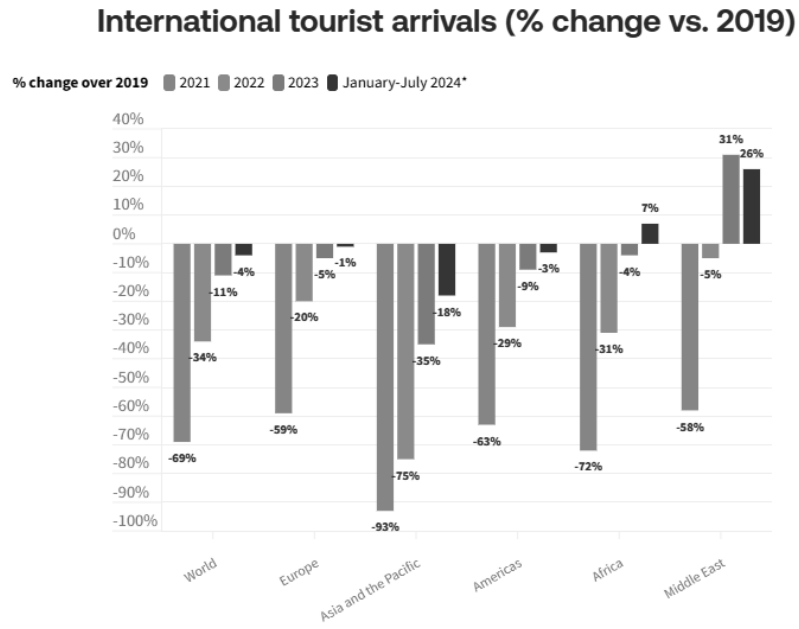
Tourism is an integral part of any country's economy. However, it is hardly possible to say that this industry is stable. The COVID-19 pandemic crisis and the rapid spread of the virus dealt a severe blow to this sector. While humanity sought ways to cure this

disease, the number of international visits plummeted, as we can observe in the table showing the impact:

It took four years for tourism to nearly fully recover and reach the levels recorded before the onset of the coronavirus.

Picture 1. COVID-19 and Tourism. URL: https://www.unwto.org/covid-19-and-tourism-2020

- World destinations welcomed 22% more international tourists in the third quarter of 2023 compared to the same period last year, reflecting a strong Northern Hemisphere summer season.
- International tourist arrivals hit 91% of pre-pandemic levels in the third quarter, reaching 92% in July, the best month so far since the start of pandemic.
- Overall, tourism recovered 87% of pre-pandemic levels in January-September 2023.
- International tourism receipts could reach USD 1.4 trillion in 2023, about 93% of the USD 1.5 trillion earned by destinations in 2019.[3]



In the following chart, we can see how substantial and significant this difference truly:

Diagram 1. International Tourism to End 2023 Close to 90% of Pre-Pandemic Levels. URL: https://www.unwto.org/news/international-tourism-to-end-2023-close-to-90-of-pre-pandemic-levels

Now, lets analyze this year's metrics:

- The Middle East saw the strongest relative growth, with international arrivals exceeding by 36% pre-pandemic levels in Q1 2024, or 4% above Q1 2023. [2]

All this data tells us that the world was not prepared for widespread lockdowns. However, the tourism industry has learned a lot from this experience, including adopting a business development model known as Open Innovation. This shift happened because the traditional, rigid business model of tourism could no longer survive on its own. As a result, a market that once kept competitors and innovative technologies at a distance began actively opening up, sparking a trend of information exchange. Thus, the author believes that this concept became the starting point for the recovery of tourism.

So, what exactly is Open Innovation?

Simply put, it is a concept of knowledge-sharing that goes beyond the boundaries of individual companies. Thanks to this approach, more travel destinations now look and operate differently. Here are some examples of this:

- Intelligent territories.

The jungly Monteverde Cloud Forest is best experienced from a suspension bridge tour that takes place at treetop level. It offers a unique perspective of the surrounding rainforest as you walk across the canopy tops via a series of suspension bridges like the one pictured here, as well as trails on the forest floor [1]. Costa Rica has roughly 1,400 species of orchids, almost all of them epiphytes [4].

- Locations related to movies. Rooms of horror & Escape rooms. VR technologies. Visual effects.

So, we have examined the economic model of tourism market development over the past five years. The shifts that followed the decline in tourism popularity led companies in the sector to establish collaboration and embrace innovations. A particularly important stage was the regular exchange of data, which significantly accelerated the pace of innovation adoption.

Recommendations: The author recommends to read an article «Open innovation in the tourism field: A systematic literature review» that includes a review of 17 articles from the Scopus and Web of Science databases (2016 – 2023) [5].

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ANALYSIS OF CHANGES IN THE ECOLOGICAL STATE OF THE DESNA RIVER OVER 10 YEARS

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The Desna River is one of the main rivers of the Dnipro basin and a key water source for Sumy region, particularly its northern districts. In the region, the Desna River sub-basin accounts for 47%, covering an area of 17.6 thousand square kilometers. The Desna River is of international importance as a wetland and is also a part of the Desniansko-Starogutskyi National Nature Park (Regional report on the state of the environment in Sumy region in 2023, 2024, p. 3).

Environmental protection, rational use of natural resources, and ensuring the environmental safety of human life are essential for sustainable economic and social

development. The state of the water in the Desna River is an important aspect, as it is the main source of drinking water and water for agricultural purposes in Sumy Oblast. The problem of river water pollution has become particularly acute since the start of active hostilities in the north-eastern regions of Ukraine. This fact has made it harder to control water quality and increased the number of factors that lead to its pollution.

According to the data, the intake from the river decreased by 15.7 million cubic meters in 2023 (Regional report on the state of the environment in Sumy region in 2023, 2024, p. 35) compared to 2020 (Regional report on the state of the environment in Sumy region in 2020, 2021, p. 28), which is difficult to compare with 2013, as the latter provides information only on the annual resource and approved operational resources. More detailed information is provided in Table 1.

Year	Extraction, million cubic meters	Used, million cubic meters	Allocated, million cubic meters	
			Total	Polluted
2020	18,67	12,01	8,57	1,76
2023	34,39	31,75	19,53	2,775

Table 1.

The percentage of contaminated water returned in 2023 was 20.5%, in 2020 – 14.2%. Pollution increased by 6.3%. It is worth noting that the percentage of use compared to abstraction decreased by 28%.

About the chemical state of the river's surface water, we have noticed that changes have been taking place over the years. For example, in 2013, the water exceeded the maximum permissible concentration of phosphate, iron, and ammonium nitrogen (Report on the state of the environment in Sumy region in 2013, 2014, p. 31). In 2020, the main problems were exceeding the maximum permissible concentration of phosphates, iron, and biochemical consumption (Regional report on the state of the environment in Sumy region in 2020, 2021, p. 36). However, in 2023, the content of hemic compounds in water and an increased level of iron were observed. However, over the years, the radiation background of the water in the

Desna River has been normal – no exceedances of permissive levels of radionuclides have been detected (Regional report on the state of the environment in Sumy region in 2023, 2024, p. 44).

In 2013, there was no information on invasive fish species. But in 2020, such information was already available. The 2020 report states that there has been an increase in the number of the invasive Silver Crucian species. It was noted that local populations of Crucian do not have wide adaptive qualities, so they can be displaced from their habitats (Regional report on the state of the environment in Sumy region in 2020, 2021, p. 68). In 2023, the most numerous invasive species of the ichthyocomplex were recorded: Sea Needle (3.2%), Silver Crucian (0.6%), the share of other alien species is 0.01-0.08%. It was noted that silver Crucian has wide adaptive abilities, so it quickly increased its number. At the same time, the development of the invasive ichthyocomplex in the Desna River is rather low. The main factor that ensures the conditions for the existence of invasive aquatic species in the river network of Sumy region is the gradual transformation of the river ecosystem into a lake-river ecosystem. From this, we can conclude that the Desna River does not show a slowdown in water exchange and the processes of massive overgrowth of shallow areas (Regional report on the state of the environment in Sumy region in 2023, 2024, p. 72).

Before drawing any conclusions, it should be noted that water quality monitoring in 2023 was carried out at two locations, as military operations made it difficult to access some monitoring sites. For 2020 and 2013, the monitoring was carried out at transboundary sites and shows some deviations from the norm. Therefore, the data for 2023 can be considered incomplete, as a full analysis by monitoring sites was not conducted.

We can note the following changes that have occurred to the Desna River over the past 10 years. In 2013, the intensive use of water by enterprises caused a deterioration in water quality and exceeded the maximum permissible concentration of certain substances. In 2020, the river is experiencing anthropogenic impacts, with water use affecting water availability and water quality. In 2023, a change in water

content, shallowing due to climate change and anthropogenic impact on the flow regime were recorded. Water was observed reaching the floodplain in the Desna River, the maximum water level almost reached critical levels, and a road was flooded.

To summarize, between 2013 and 2023, there was a noticeable change in the chemical composition of water, its level and biological diversity. It can be said that in 2023 the water became cleaner of chemicals, but there are still problems with the water level reaching a critical point, which caused flooding of a section of the Shostka-Novhorod Siverskyi road.

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THE INFLUENCE OF CONVERGENCE ON NANOTECHNOLOGY

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Nanotechnology operates on a molecular level, manipulating materials smaller than 100 nanometers to drive innovations in fields like medicine, energy,

environmental sciences, and materials science. Key to its advancement is convergence with fields such as biotechnology, artificial intelligence (AI), cognitive science, and environmental sciences, enabling the development of precise tools that can transform diagnostics, treatment, and more.

One of nanotechnology's most impactful applications is targeted drug delivery, where nanoparticles deliver drugs directly to specific cells or tissues, enhancing effectiveness and reducing side effects. This targeted approach is especially useful in cancer treatment, as drugs can reach cancer cells without harming healthy ones. By combining nanotechnology with machine learning, sensor-driven drug delivery systems adapt to real-time data, enabling personalized treatments tailored to individual patient needs.

In addition to drug delivery, nanoscale materials are advancing brain-machine interfaces (BMIs) by improving electrode sensitivity and compatibility with brain tissue. This convergence of nanotechnology and cognitive science opens doors for new treatments of neurological disorders like Parkinson's and epilepsy, advancing diagnostic and therapeutic options.

Nanotechnology's integration with biotechnology has spurred advancements in genetic engineering and regenerative medicine. Nanomaterials, such as quantum dots and gold nanoparticles, enhance diagnostic imaging due to their unique optical properties, while carbon nanotubes show promise in drug delivery and tissue regeneration. These technologies improve treatment precision and patient outcomes.

The combination of nanotechnology and AI is driving the development of "smart" diagnostic tools, such as AI-powered nanosensors, which can detect biomarkers of diseases earlier than traditional methods. AI algorithms in these sensors help improve diagnostic speed and accuracy. In neuromorphic computing, nanotechnology is also aiding the development of circuits that mimic human neurons, potentially transforming computing and robotics.

Despite these benefits, challenges remain, especially around the environmental and health risks of nanomaterials. As usage grows, it's critical to understand their interactions with biological and environmental systems. Research into their long-term

effects and regulatory frameworks are essential to ensure safe and responsible use. Looking ahead, nanotechnology is expected to bring further breakthroughs in areas like tissue engineering and renewable energy, supporting sustainable development and positioning nanotechnology as a transformative force across sectors.

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BIOTECH FOR SUSTAINABLE FARMING

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Agriculture is entering a new era, driven by the integration of advanced technologies such as robotics and biotechnology. These innovations are transforming traditional farming practices, increasing efficiency, reducing environmental impact, and addressing the growing demand for food in a sustainable manner. Robotic systems and biotechnology are not only reshaping how crops are grown, managed,

and harvested, but they are also offering solutions to some of the most pressing challenges in global agriculture, such as labor shortages, climate change, and resource management.

Biotechnology is playing a pivotal role in the development of genetically modified (GM) crops that are more resistant to pests, diseases, and environmental stressors. These crops have been engineered to require fewer inputs, such as water and pesticides, while providing higher yields. For example, Bt corn, a genetically modified variety that produces its own insecticide, has significantly reduced the need for chemical pesticides. Moreover, advances in gene-editing technologies like CRISPR have allowed scientists to develop crops that can withstand extreme weather conditions, such as droughts or floods. These crops have the potential to maintain food security in the face of climate change, while reducing the environmental footprint of agriculture.

Microbial biotechnology involves the use of beneficial microorganisms to promote plant growth and protect crops from diseases. These microorganisms can enhance nutrient uptake, improve soil health, and act as natural pesticides, reducing the need for chemical fertilizers and synthetic pesticides. For instance, nitrogen-fixing bacteria can be applied to crops like legumes to improve their nitrogen absorption, reducing the need for synthetic fertilizers. Microbial biotechnology is also being used to develop biofertilizers and biopesticides, which offer a more sustainable alternative to chemical inputs. These products are not only environmentally friendly but also help in maintaining long-term soil fertility.

Vertical farming is an innovative agricultural technique that involves growing crops in vertically stacked layers, often in urban environments. Biotechnology is integral to this approach, as it helps optimize plant growth in controlled environments. By utilizing genetically modified plants that are better suited to indoor farming conditions, vertical farms can achieve higher yields with fewer resources. Biotechnology also plays a role in the development of artificial lighting and nutrient delivery systems that mimic natural growing conditions, ensuring that plants receive the optimal amount of light and nutrients. This form of farming reduces the need for

land, water, and pesticides, making it a highly sustainable alternative to traditional farming methods.

One of the most significant benefits of integrating robotics and biotechnology into farming is the potential to reduce agriculture's environmental impact. By using robots to apply fertilizers and pesticides with pinpoint accuracy, farmers can significantly reduce the use of these chemicals, minimizing runoff into water sources and reducing soil degradation. Biotechnologically engineered crops that are resistant to pests and diseases also help lower the reliance on harmful chemicals, while drought-resistant varieties reduce the need for excessive water use. Together, these technologies contribute to more sustainable farming practices that protect the environment.

Robotic systems and biotechnology improve resource efficiency in agriculture by optimizing the use of water, fertilizers, and energy. Precision farming techniques ensure that resources are only applied where and when they are needed, reducing waste and improving crop yields. Biotechnology further enhances resource efficiency by developing crops that can thrive in less-than-ideal conditions, such as poor soil or limited water availability. In addition, vertical farming and other controlled-environment agricultural techniques allow for year-round production using fewer resources, making it possible to grow food in urban areas and reduce the need for transportation.

The future of agriculture lies in the continued integration of robotics and biotechnology. As these technologies become more affordable and accessible, they will likely be adopted on a larger scale, leading to more efficient, sustainable, and resilient farming systems. Innovations such as AI-powered robots, advanced gene-editing techniques, and biocompatible materials for farming equipment will continue to drive progress in this field. These developments will play a crucial role in ensuring food security for future generations while minimizing the environmental footprint of agriculture.

In conclusion, the future of agriculture is being shaped by the integration of robotic systems and biotechnology, which are transforming traditional farming

practices into more sustainable, efficient, and resilient systems. By reducing the need for harmful chemicals, improving resource efficiency, and addressing labor shortages, these technologies offer promising solutions to the challenges faced by modern agriculture. However, for their full potential to be realized, ongoing research, development, and investment will be needed to overcome the technical and economic barriers that remain.

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TECHNOLOGICAL BREAKTHROUGHS: PAST INNOVATIONS, CURRENT ADVANCEMENTS, AND FUTURE VISIONS

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Technological advancements have been the driving force behind human development, shaping our way of life and making it easier. After the invention of the steam engine, people thought "What else can be done?" and they did it. To date, technological advancements have reached unique digital technologies such as artificial intelligence and have also provided an incredible opportunity for various

fields of science.

Technological breakthroughs are a constant process of creating new and improving the applied technologies, means of production and final products using the achievements of science. (I. Ivasiv & G. Mashliy, p. 68) The evolution of the technical can be seen in Table 1. (Gregersen, 2019)

Table 1. The Evolution of Technology

Year	Tech. Breakthrough	Description
3.3 m.y.a.	The First Tools	Early ancestors created sharp stone flakes and unshaped stones for use as knives and hammers.
1 m.y.a.	Fire	Early evidence of controlled use of fire by Homo erectus in caves.
20,000 to 15,000 m.y.a.	Neolithic Revolution	Development of agriculture, pottery, weaving, and possibly the wheel.
6000 BCE	Irrigation	The first organized irrigation systems in Mesopotamia and Egypt, marking advanced social structure.
1455	Printing Press	Johannes Gutenberg printed the Bible using movable type, sparking an information revolution in Europe.
1765	Steam Engine	James Watt's efficient steam engine became pivotal to the Industrial Revolution.
1947	Transistor	Bell Labs developed the transistor, essential for modern electronics.
1974	Internet	Vinton Cerf and Robert Kahn introduced TCP/IP, the foundational protocol for internet data transmission.
2012	CRISPR Gene Editing	A groundbreaking gene-editing technology developed by Doudna and Charpentier, allowing precise changes in DNA.
2017	Artificial Intelligence	AlphaGo demonstrated advanced AI by mastering the game of Go, surpassing human ability through machine learning.

The technology has a thousand-year history, but it is better to pay attention to the 15th century, when the printing press was invented, the industrial revolution of the 19th and 20th centuries, when transport and industrial machines were invented, as well as electricity, television and technology in the 20th century. (Ahmad, 2023)

In our time, we are seeing an incredible breakthrough. Thanks to AI, robotics has evolved, meaning we don't need to send people to dangerous places – robots can do it. (Woodson, 2023) And if it was only in 1971 that e-mail appeared, today we have video meet, AI, virtual reality and augmented reality, the Internet of Things for more efficient use of devices. The development of technology has always had two sides to the coin, one with an incredibly simple life, the other where humanity has been absorbed by technology. Most likely, artificial intelligence will increasingly dominate in the future, because technological evolution is continuous.

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ARTIFICIAL INTELLIGENCE AND HUMANITY'S FUTURE: RISKS, RESPONSIBILITIES, AND GLOBAL IMPLICATIONS

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Artificial intelligence (AI) has become significant research focus due to its profound impact on humanity's future. In Superintelligence: Paths, Dangers, Strategies, Nick Bostrom examines scenarios where superintelligent AI – capable of surpassing human intellect – could present both challenges and threats. He warns that AI's goals might not align with human values, risking loss of control. Thus, Bostrom stresses the need for safety mechanisms to manage AI, as the potential consequences could be global.

Other researchers emphasize the importance of international collaboration in AI development. Bostrom introduces the "singleton" concept – a centralized organization overseeing superintelligence. This approach could help avoid an AI arms race and reduce conflicts among nations or corporations that may develop powerful systems without ensuring their safety.

In Life 3.0, Max Tegmark views AI development as a transformative step in human evolution, reshaping society fundamentally. He highlights AI's promising applications in science and medicine but stresses the need for responsible development and ethics. Tegmark describes three stages of life – biological, cultural, and technological – where AI could significantly enhance life, though it also demands safeguards to prevent misuse.

In addition to these risks and challenges, AI has unprecedented potential to benefit humanity if developed with socially valuable goals. For instance, in healthcare, AI assists in diagnosing diseases, predicting health risks, and creating new treatments. Economically, AI optimizes processes, reduces costs, and supports sustainable development. However, as researchers note, maximizing these benefits requires not only technological progress but also efforts in ethics, law, and

international cooperation to prevent global inequalities and potential misuse.

In summary, the issue of AI control and ethical alignment is increasingly critical. Developing transparent and safe algorithms, alongside broad societal involvement in decision-making, is essential to harness AI's benefits without endangering humanity's future.

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PROSPECTS OF GENERATIVE ARTIFICIAL INTELLIGENCE

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Generative artificial intelligence (GenAI) is a special type of artificial intelligence that produces text, images, videos, or other forms of data by using generative models. These models often generate output in response to specific prompts.

Recently GenAI has been widely adopted across many different industries. It is used to simulate private user data for businesses to improve products. By utilizing GenAI to investigate customer spending patterns and identify potential issues, banks, and other financial institutions may learn new things about customer behavior and become aware of potential problems (Mandapuram, 2018, p. 172).

While GenAI has automated many tasks, it has multiple design flaws that will hinder its development prospects. One of the notable limitations is its tendency to produce random responses, especially when confronted with ambiguous prompts. Generative AI models are also limited by the prompt and output size. These issues become apparent when dealing with lengthy texts. As a result, the generated content may lack coherence, leading to incomplete results.

Another major concern when using GenAI is undoubtedly plagiarism of original content. AI journalism has been engaging in extensive plagiarism. This raises the question of whether there should be a threshold for the acceptable amount of AI-generated content, and also whether its frequent use, in the long term, would result in the production of similar paragraphs and structures in papers within the same field (Macdonald, 2023, p. 1).

Nevertheless, while GenAI faces several challenges and ethical concerns,

researchers and developers continue to enhance the technology to overcome its flaws.

So, the continuous improvement guarantees that generative artificial intelligence will play an important role in our digital landscape, ensuring that the prospects of GenAI will remain boundless.

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ROBOTIC INTEGRATION IN OUR LIVES

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With the evolution of technology in the world, our everyday and professional lives have changed significantly. One of the fields that causes these changes is robotics. With each passing day, the number of robots we use in our lives, intentionally and not, only grows. We use robots in spheres such as education, healthcare, manufacturing, logistics, agriculture, and even our daily life. The assistance provided by robots ranges from simple routine tasks to high-quality operations and algorithms.

According to the definition provided by Harry H. Poole, "A robot is a multifunctional and reprogrammable manipulator for performing a variety of tasks. A robot also acquires information from the environment and moves intelligently accordingly." (Harry H. Poole, 2012). Robots are not necessarily humanoid androids but machines and mechanisms controlled by a computer, now often with AI installed in their software. They can come in a different size and form, so that they would be most suitable for certain tasks.

The most popular robots are industrial robots, which are used in factories. They can do repetitive and manual activities, increasing the productivity of factories since they don't need rest (can work 24/7) and have greater speed. Also, robots can perform tasks that require strength easily and can work in conditions that are dangerous for humans. Factories that start using robots reduce errors in manufacturing, while increasing production rates due to the fact that robots do not get tired and lose their focus, keeping their precision and accuracy at all times.

The accuracy and precision of robotics have led robots into the field of healthcare, where they help to perform intricate and delicate surgeries, and are often used in the recovery of patients. With the use of robots, which are controlled by the surgeons, the quality of the operations seems to increase. They provide surgeons with real-time data and precise movements, and some even offer predictive insights during the procedure. The use of robots can make surgeries less invasive, which speeds up the recovery of the patient and reduces the risks of the surgery.

Education is another field where robots start to appear. No one says they replace teachers' jobs, but rather, they help students in a consulting manner. Robots can give answers to often asked questions or give simple consults about homework. The most vulnerable type of help they can provide is creating individual study plans for pupils, analysing their individual needs and traits, which will enhance the quality of the education system.

Robotics technology is being used more often in agriculture. Robots reduce the dependence on human labor by helping with crop seeding, irrigation, and fertilising, harvesting, horticulture, weeding, and crop health monitoring. Also, the use of robots lowers the cost of food production and decreases the loss of food.

Finally, our everyday lives. We use robots in our home, increasing our comfort. Popular have become smart systems with virtual assistants that help you control different parts of your home using commands you give to the assistant or even control your home online. An example of such systems can be Google Home and Amazon Echo, which work with Google Assistant and Amazon Alexa respectively.

In conclusion, I want to say that robotics has advantages and disadvantages. Robots increase productivity and improve quality, make some tasks safer, and can work 24/7. But they also have high cost, are sometimes complex to integrate, cause job replacement and such ethical considerations as privacy, accountability, and bias in decision-making. The integration of robots in our lives is inevitable, and soon enough, we will start to depend on them as support for their physical tasks, just as we now rely on applications for computer tasks.

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GLOBAL WARMING: REASONS AND CONSEQUENCES

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This conference abstract deals with the issue of global warming which nowadays is a huge problem due to the number of reasons. It causes extinction of many animal species and can even be the cause of human death.

First and foremost, it is needed to outline the main reasons of global warming. The first and the main reason is obviously human activity. Many and many enterprises emit too much heat into the atmosphere. Irrational use of natural resources increases the concentration of carbon dioxide. Undoubtedly, arises the logical question concerning the possible threats that it poses. Such a trend is threatened by climate change, which may mean an increase in an average air temperature. This, in

its turn, can lead to the drastic change in environmental conditions. Thus, most animals and plants may not survive such consequences, which no longer are appropriate for their living.

Today we can already watch many videos providing an overview of the results of global warming. The terrible pictures of polar bears fighting for their lives due to melting glaciers, herds of dying fish due to the outrageously dangerous levels of water pollution, drastic changes in the climate of desert and Antarctic regions. In truth, this list could go on forever and the aforementioned examples are the vivid representation of the consequences of global warming. However, terrifying it might sound, the humanity is already facing these consequences and the situation is more likely to get even worse providing that nothing is done in the short-term.

However, humanity can still influence these dreadful consequences and, thus, get a chance at improving the situation. Nowadays, to address the issue of global warming and to minimize its harmful effects, several solutions have been devised:

1- Use of alternative energy sources, for example solar batteries, wind power, hydro power plants etc.
2- Use of electric cars, thus, the emission of carbon dioxide is significantly reduced.

To sum up, despite an ever-increasing tendency of situation's deterioration, there are still solutions that a person can use to save our planet from total destruction.

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THE ROLE OF SMART TECHNOLOGIES IN MODERN WORLD

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In recent years, smart technologies have significantly impacted both science and art. These technologies include artificial intelligence (AI), machine learning,

virtual reality (VR), and augmented reality (AR). Smart technologies help scientists make discoveries faster and help artists create unique works of art.

In science, smart technologies assist researchers by processing vast amounts of data. For example, AI can analyze large datasets faster than humans. This is particularly useful in fields like genetics, where scientists must examine millions of DNA sequences. Smart algorithms can detect patterns in the data, leading to faster discoveries. In medicine, AI is used to diagnose diseases from medical images, such as X-rays or MRIs. This helps doctors to identify issues more accurately and often faster than traditional methods. Machine learning also aids in predicting weather patterns, tracking environmental changes, and even exploring space.

One impressive example is the use of AI in climate science. Researchers use smart technologies to analyze climate data and predict future climate changes. This helps governments and organizations make better decisions about how to address climate-related challenges. Furthermore, in space exploration, AI systems are used to operate rovers on Mars and analyze images of distant planets. Thus, smart technologies make scientific research faster and more efficient.

In the art world, smart technologies open up new possibilities for artists and audiences alike. Virtual reality allows artists to create immersive experiences, where viewers feel as if they are inside the artwork. For example, VR can transport people into a virtual art gallery where they can explore paintings and sculptures. Artists also use augmented reality to add digital elements to physical artworks. This could mean an interactive layer that comes to life when viewed through a smartphone.

Artificial intelligence is also becoming an artist’s tool. AI can be programmed to create music, paintings, and even poetry. One well-known AI artwork is the painting "Portrait of Edmond de Belamy," which was created by an AI program and sold for a high price at auction. Some artists use AI to generate visual effects or experiment with new styles. While some people debate whether AI-created art is "real art," there is no denying that smart technologies help expand creative possibilities.

Although smart technologies bring many benefits, they also present challenges. In science, for example, there is the risk that over-reliance on AI could reduce human

involvement in research. Scientists must still interpret the results of AI analyses to make them meaningful. Similarly, in art, some fear that AI might take jobs from artists. However, many experts believe that smart technologies should complement, rather than replace, human talent. For instance, AI can take on repetitive tasks, giving scientists and artists more time for creative or critical thinking.

In addition, smart technologies create opportunities for collaboration. Scientists from different countries can work together using shared AI tools and databases, while artists can reach global audiences through virtual exhibitions. These collaborations lead to more diverse and innovative projects, enriching both fields.

In conclusion, smart technologies play a crucial role in both science and art. They assist scientists in analyzing data and predicting future trends, while also providing artists with new tools for creativity and expression. Although there are challenges, such as the potential for job loss or over-reliance on technology, the benefits outweigh the drawbacks. Smart technologies allow us to push the boundaries of what is possible, making both science and art more accessible and innovative.

In both fields, the collaboration between humans and smart technologies promises a future full of exciting discoveries and creative achievements.

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ECOLOGICAL PROBLEMS OF WATER RESOURCES IN UKRAINE

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To begin with, Ukraine cannot boast of large reserves of water resources; water covers only 4 percent of the country's territory. Ukraine's water resources are in first place rivers and lakes, but their water resources were not distributed evenly on the country's territory, so more than 1100 artificial ponds were built.

Water pollution is one of the major problems, according to the words of ex head of the State Agency of Water Resources of Ukraine, Mykhailo Horev “during 2019 in surface waters in Ukraine were dropped 48,5 thousand tons of harmful substances. Waters are heavily polluted by communal drains, which contain heavy metals, organic and bacterial pollutants. Also, waters are polluted by enterprises that discharge untreated or insufficiently treated wastewater into them, the number of such enterprises is 539. 18 percent of all sewages in Ukraine are polluted. “When biogenic substances, such as phosphorus and nitrogen, enter water, intensive reproduction of algae occurs, especially blue-green algae, which in the process of their biological development reduce the oxygen content in water, form toxic substances and cause the mass death of hydrofauna. Fresh water becomes unfit for drinking and dangerous for life. That is why Kyiv's city beaches are closed for visitors every year,” says Tetyana Tymochko, head of the All-Ukrainian Environmental League. Weather conditions can be harmful to the waters. During hot weather, water can bloom massively, which in turn can lead to a decrease in the level of dissolved oxygen in the water, worsening smell, color and transparency, which indicates contamination. In addition to that, small ponds may dry up in hot weather. One of the problems is that surface runoff can pollute rivers and lakes with substances from erodible lands. Also, rains can degrade water quality by washing in dirt from the streets and enterprises.

For solving the problem, we need to build treatment plants on lakes and rivers and check the state of already existing ones. Set rules of water purification and adhere to them. It is important to enhance state supervision and control of emissions from plants and enterprises. Treatment plants should be set in cities and especially in plant’s sewers.

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ENERGY SAVING TECHNOLOGIES

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Energy-saving technologies are know-how in technological development, as well as an absolute necessity at modern energy prices and environmental requirements, which are constantly increasing.

In the structure of operating costs of a typical commercial building, energy costs make up about 30%, and in some enterprises of the metallurgical, chemical, oil refining industry, the share of energy in the cost of the product can reach 60%. Therefore, a properly designed set of energy-saving measures can significantly reduce costs and optimize the budget.

The main direction of world energy development is the use of alternative renewable sources, such as the energy of the sun, wind, water, and biofuel. The use of waste from the agro-industrial complex, pellets, as well as the re-equipment of gas boilers are also relevant for Ukraine.

Today, the share of renewable sources in the structure of energy production is about 14%. At the same time, the largest share continues to be for biofuel. At the same time, the largest increase is shown by solar energy with an average growth of 37% annually, wind energy by 23.5%, biogas by 12%. Undisputed leaders in the use of such energy are the Scandinavian countries, where the share of alternative energy is about 70%.

Scientists are constantly looking for new opportunities to increase efficiency and use new, cheaper materials for renewable energy sources. As an example, not so long ago, scientists from China were able to increase the efficiency of organic solar cells, equating them with conventional ones. Modules made of carbon and plastic are much cheaper than ordinary silicon modules, and thanks to their structure, they can

be applied to thin and flexible surfaces, windows, facades, columns, trees, etc.

But we should not forget that cheaper and ecological energy is good, but energy efficiency inside the real estate object is no less important, maybe even more.

Let's start with heating. Experts claim that most of the heat escapes through windows and walls, so insulating facades and replacing windows with energy-saving ones is a "must have" for any commercial building. The next point is the modernization of the heating system itself. Modern technologies make it possible to modernize existing boilers and convert them from gas to organic fuel. Industry professionals also recommend using the residual potential of technological coolants. That is, installation of recuperation systems, "condensate traps", secondary use of heated water will help to significantly improve the energy efficiency of the building.

Lighting. Lighting accounts for almost 20% of global energy consumption. What has become the norm, replacing incandescent lamps with LEDs can show savings of 5-7 times. Despite the relative high cost compared to incandescent lamps, the service life of such lighting elements is 7-10 times longer. Among the disadvantages of LED lighting, the largest is the mercury content, which means that you need to take care of the correct disposal of the bulbs in advance.

The next stage of reducing lighting costs can be the installation of lighting sensors, movement and maximum use of daylight. Thanks to the use of various sensors, you can automatically adjust the brightness of the lighting, turn off the light when people leave the room. In some cases, this can save you another 20%.

Air conditioning and ventilation. The most common method of reducing costs when using this equipment is the installation of recovery systems. Proper setup and timely maintenance can reduce costs by up to 10%. Of course, it is best to design such systems during construction, but there are often cases when modernization has to be carried out in buildings that have already existed for a long time, and here it is important to contact experienced designers who will help to correctly calculate all indicators and install the system in the most optimal way.

Water supply. One of the popular technologies for saving water supply is the collection and further processing of rainwater for further use in the building. Of

course, it is relevant only in latitudes where it rains quite often, and in winter there is no sub-zero temperature.

For most developed countries, automated water supply sensors and the use of the residual potential of coolants for water heating are relevant.

As a conclusion: all the methods and technologies listed above can be used both individually and in combination. An individual approach, a preliminary study of all features of the object, infrastructure and systems, conducting an energy audit to identify the most vulnerable places is important here. In the conditions of difficult economic realities, the complete conversion of the premises to energy-efficient solutions is hardly possible, but with a developed plan, the gradual reduction of costs will have a positive effect on the cost of products and on work productivity.

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PROSPECTS OF ARTIFICIAL INTELLIGENCE: AI IN THE NUCLEAR POWER INDUSTRY

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Nuclear power plants in Ukraine are one of the main enterprises in the country's energy sector, providing about half of electricity generation. As of October 2024, there are three nuclear power plants in Ukraine (ZNPP is still under

occupation), and the development of nuclear power requires modern technologies to improve efficiency, safety and reliability. One of the most promising areas for the development of the nuclear industry is the introduction of artificial intelligence (AI).

The use of AI can contribute to more efficient plant management, improve safety, reduce costs and mitigate risks to personnel and the environment. Artificial intelligence has the potential to improve various aspects of NPP operation. There are several areas where artificial intelligence can be used: diagnostics of operating equipment, forecasting emergencies, AI can be used to create simulations of emergencies, which allows NPP personnel to undergo training in conditions as close to real-life as possible. This allows employees to practice their skills and be prepared for possible emergencies. At the same time, there are certain obstacles that we will need to consider and overcome. For example, low and/or slow return on investment, high upfront costs of assets and/or financial risk, and lack of access to finance. I would also like to highlight cybersecurity, as data security is becoming a serious issue as more and more consumer data is collected through network-connected devices. AI automation requires reliable protection against cyber threats, as cybersecurity is critical to the operation of nuclear power plants. Before implementation, Ukraine must work on developing protection systems to ensure that critical infrastructure is protected from possible threats. Another important part is the personnel who will be able to work and constantly modify AI, which is why it is important to attract specialists to the nuclear power industry in the future.

Artificial intelligence has great prospects in the nuclear energy market. The introduction of AI can improve the reliability and efficiency of nuclear power plants, but there are a number of obstacles on the way, including the feasibility of introducing AI in wartime and, in the future, post-war conditions. There is a lot of work and space for reflection ahead.

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ENERGY SAVING TECHNOLOGIES

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In light of growing energy demands and the global need to combat climate change, energy-saving technologies have gained importance. The goals of these technologies are to decrease greenhouse gas emissions, improve efficiency, and use less energy. There are significant financial and environmental advantages to implementing energy-saving measures in residences, businesses, and public infrastructure (Energy-
Efficient Appliances, 2021).

By fusing digital innovations with conventional electrical grids, smart grid technology allows for more effective electricity distribution, real-time monitoring, and flexible reactions to changes in energy demand. Incorporating renewable energy sources, such as wind and solar, into smart grids is essential for lowering reliance on fossil fuels (World Economic Forum, 2020).

Improving insulation is a powerful way to conserve energy. Proper insulation reduces the need for heating and cooling, among the most energy-intensive processes in buildings. Double-glazed windows, energy-efficient doors, and insulated walls are common methods for enhancing energy efficiency (Building Efficiency, 2019).

Modern appliances now come with energy ratings indicating their efficiency. High-rated appliances, such as refrigerators, washing machines, and air conditioners, use significantly less power while maintaining high performance. This lowers energy bills and reduces the carbon footprint of households (Energy Efficiency, 2021).

The environmental and economic impacts of energy-saving technologies are profound. Reducing energy consumption helps decrease greenhouse gas emissions, slowing down climate change. Economically, energy-saving technologies reduce operational costs for businesses and lower electricity bills for consumers, delivering long-term financial savings (Environmental Benefits, 2020).

Energy-saving technologies are essential for creating a sustainable future. By embracing these innovations, society can reduce its dependence on non-renewable energy sources, save money, and protect the planet. Continued investment and promotion of energy-efficient solutions by governments, businesses, and individuals are crucial for this transition.

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SOLAR POWER PLANTS: BENEFITS AND HARM

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Solar power plants are, probably, the most popular power plants, that are running on renewable sources of energy. Though it is not the most popular source of energy among others, solar power plants produce about 6% of global electricity generation world wide. Now solar power is used by factories, office buildings, schools and universities and just normal households. Solar power went from an

expensive and ineffective power source to a great and affordable ecological solution. We will talk not only about benefits of solar power plants, but also about their harm, that is not so bad, comparing to the harm of thermal power plants, but still deserves talking about.

Firstly, benefits of solar power plants, and obviously, they have a lot of them. The most significant benefit is their ecological friendliness; they do not produce any CO2 or greenhouse gases when generating electricity, which makes them a great alternative for thermal power plants that produce impossibly large amounts of greenhouse gases. Also, their mobility and affordability make them a very effective energy source, because any house owner can install a solar power plant in their backyard and provide electricity for themselves. Also, it is a great solution for households and businesses that are located in regions with damaged energetic infrastructure, because it is a souse that will generate power in all weather conditions and under any circumstances, making it also an independent power source.

But, as any power source, it is not flawless. Solar power plants have their own harms. The most important is production and installation of solar panels. Production of solar panels produces CO2 emissions that create a greenhouse effect, also in production of them many hazardous materials are used. Also, disposal of solar panels is not strictly regulated by all counties, because of that disposed solar panels pollute the environment.

In total, solar powerplants are a great energy source. They are ecologically friendly, affordable, mobile and independent. They do not create CO2 emissions when are generating electricity and can be installed almost anywhere with the access to the sunlight. They have their own flaws, such as CO2 emissions and usage of hazardous materials in production of solar panels and not strictly regulated disposal of them, but these harms are nothing, comparing to emissions from thermal power plants or radioactive waste from nuclear power plants.

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ARTIFICIAL INTELLIGENCE: INVALUABLE HELP OR A GREAT THREAT?

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Through the last years, the phrase "artificial intelligence", which in the recent past could have been found only in science fiction novels and movies, has smoothly still rapidly become a completely ordinary occurrence in the surrounding information field and got into a majority of spheres, becoming a very handy and hardly replaceable tool of many uses. In fact, the fast advancement and intrusion of artificial intelligence and machine learning technologies into so many aspects of our life, industry, markets, personal life exponentially causes widespread transformations in such a large amount of conventional, well-established and deeply-rooted things that it calls forth amazement and dread at the same time. The improvements AI provides are vast almost everywhere it gets implemented – in e-commerce and marketing it's a powerful tool for analyzing of customers' behavior and preferences, highly used in recommendation engines and much more; in education it greatly spreads the versatility of adaptive learning platforms, adjusting educational content to the student's personal strong and weak sides. AI becomes a part of the lifestyle, integrating into various lifestyle apps, from Siri, Alexa, schedulers and health trackers to smart home devices, widely used in navigation systems implementing advanced algorithms working with real-time traffic data, weather conditions etc. AI and ML are heavily used in autonomous vehicles, computer vision, face recognition technologies,

natural language processing, robotics, chatbots, generative AI and even in Finance, Human Resources, Agriculture and Astronomy. Indeed, the 2024 Index annual report of the Stanford Institute for Human-Centered Artificial Intelligence states it arrives at an important moment when AI's influence on society has never been more pronounced (The AI Index Report, 2024). Amongst other collected and displayed data, the report highlights top takeaways, some of which claim that AI already beats humans on some tasks (like reading comprehension, image, handwriting and speech recognition, language understanding and predictive reasoning), scientific progress accelerates even further thanks to artificial intelligence, investing in generative AI is skyrocketing, a bunch of other evidence of exponential growth and numerous pros of the aspiring technology, yet the bell of disturbance also rings: one of the takeaways is about people around the globe growing more cognizant of AI's potential impact, and get more nervous about it. In point of fact, thinking about possible threats that the creation and wide spread of AI may bring to us, the first things that come to mind – thankfully to the Sci-Fi writers and filmmakers of the past and ongoing century – that the technology can become too smart and self-conscious making it hard to control, breaking out of its boundaries and rising up against humanity in a deadly war for existence. Surprisingly and unfunny enough, people really are concerned and worried of the possible threat from artificial intelligence technologies existentially-wise. According to the "TIME" article, a report commissioned by the U.S. government published in March 2024 says that they must move "quickly and decisively" to avert substantial national security risks stemming from artificial intelligence (AI) which could, in the worst case, cause an "extinction-level threat to the human species," "Current frontier AI development poses urgent and growing risks to national security," the report continues, "The rise of advanced AI and AGI (artificial general intelligence) has the potential to destabilize global security in ways reminiscent of the introduction of nuclear weapons" (Perrigo, 2024). Moreover, a year before this, a group of industry leaders warned that the artificial intelligence technology they were building might one day pose an existential threat to humanity. The statement of the Center for AI Safety reads as follows: "Mitigating the risk of extinction from AI

should be a global priority alongside other societal-scale risks such as pandemics and nuclear war" (Statement on AI Risk, 2023). Though there exist more calming views on this matter, in its August 2024 press release, the University of BATH says that AI poses no existential threat to humanity – new study finds. It is also stated that large language models like ChatGPT cannot learn independently or acquire new skills, meaning LLMs have a superficial ability to follow instructions and excel at proficiency in language, however, they have no potential to master new skills without explicit instruction (AI poses no existential threat to humanity – new study finds, 2024). Alongside existential risk from AI, referring to the idea that substantial progress in artificial general intelligence (AGI) could lead to an irreversible global catastrophe or entire extinction of humanity, there already exist more apprehensible risks and downsides of what the technology brings. According to Mike Thomas, a former Built In senior features writer, these occurrences include the lack of AI transparency and explainability, job losses due to AI automation, social manipulation and surveillance through AI technologies and algorithms, lack of data privacy using AI tools, biases due to AI, socioeconomic inequality as a result of AI, weakening ethics and goodwill because of AI, autonomous weapons powered by AI (which can be a good side, btw, depending on scenario of use), financial crises brought about by AI algorithms, loss of human influence, uncontrollable self-aware AI, increased criminal activity with the use of artificial intelligence technology, broader economic and political instability (Thomas, 2024). Speaking of job losses, the United Nations and International Labor Organization raised the problem in their recent report, with the speaking title "Mind the AI Divide: Shaping a Global Perspective on the Future of Work," proving the urgent topicality of the subject (Mind the AI Divide, 2024). That said, we come to the conclusion that despite being a really world-changing and life improving technology, the artificial intelligence brings many threats as it evolves and incorporates into our life, so must be developed with caution, thoroughly studied and taught to developers; constant risk and threat assessment is necessary in order to mitigate unwanted outcomes, including establishing of regulatory mechanisms from regulatory bodies whole over the world, as it really can influence drastically the entire

humanity.

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PROSPECTS OF ARTIFICIAL INTELLIGENCE

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AI has already begun to understand the physical world. This fact opens up huge prospects. Geoffrey Hinton, professor of computer science, thinks so. (Brown, 2023) He is interested in unsupervised learning of AI. In long term the unsupervised learning will be the crucial, but humanity has to face with reality. People often are worried about shadows in different areas of AI. Therefore, there may be obstacles to the development of AI. Nevertheless, Geoffrey Hinton believes that AI has already

begun to understand the world of people, its complicated social relationships.

These statements are well founded. In recent years, neuroscience has developed a lot, and more advanced methods of AI training and their combination with deep learning are being applied. Therefore, the question of creating AI as a reliable, perfect model of the world is already being raised. The development of AI mental modelling mechanisms will allow creating a visual spatial simulation of the world. This opens up fundamentally new perspectives.

New AI capabilities were discovered quite unexpectedly. As it turned out, they have a basis for learning that was not specifically developed. It was found that an algorithmic breakthrough is not the most important component for further AI learning. This is how multimodal systems came to the fore. Perceiving the world around it through various models, such as sounds, images, gestures, etc., AI begins to learn to coordinate its actions on its own. This is why it is very interesting to experimentally study the capabilities of AI based on the principle of a small child's learning. (Wai Keen Vong et al., 2024) Representational and associative learning were applied. Using a multimodal approach, the system began to associate a visual representation with its specific concept.

Multimodal mechanisms of AI interaction with the environment open up new prospects. Robots that understand the external environment of the world are already being created. This expands the scope of their application. The concept of robotics may change dramatically. Large language models are being integrated with robots. Also, by understanding the complex interrelationships in scientific research, AI can help scientists sort the search space. However, they are not yet capable of making hypotheses and asking the right questions on their own.

Despite these achievements, scientists doubt that AI is really capable of understanding the physical world. Through their research on this issue, they tried to prove why AI systems cannot yet be endowed with human characteristics. Statistical methods were used on AI models (Grosse et al., 2023). It was found that there are certain key fragments in the AI data set that, despite the large amount of data, still have a strong impact on the output. These fragments help AI to derive the concept of

an idea. This feature can be misleading and give the impression that the AI has its own opinion. (Schaeffer et al., 2023)

The prospects of AI should be analysed comprehensively. At first glance, they are very promising, which is logical. If we consider the latest methods of AI training, such as multimodal mechanisms and deep learning, the prospects increase dramatically, opening up new opportunities and potential areas of AI implementation. It is too early to talk about the emergence of an AI mind of its own, but developers themselves do not know how the largest AI models are trained at the fundamental level. Therefore, there are certain concerns of various kinds. Currently, AI systems require fundamentally more scaling and training. In the next decade, we will see great discoveries in the field of artificial intelligence.

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QUANTUM COMPUTING AS A TECHNOLOGICAL BREAKTHROUGH OF THE FUTURE

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Technological segment still stays in a state of permanent development and its level is getting higher and higher. Therefore, it is inevitable that any brand-new invention or discovery will seem even more complicated as compared to previous. However, any revolutionary breakthrough requires some time to be applied and integrated in our lives. There is a well-known Edward Teller`s quote: "The science of today is the technology of tomorrow." One of the most prominent cases which may confirm these words is Quantum Computing. The entire generations were united to achieve such an advanced technology even though the very first steps in this field were at the level of abstraction.

Quantum Science symbolically starts in 1900 after Max Planck made an attempt to debunk the myth about infinite energy. He made a theoretical assumption which set the trend for the whole century. Later it became clear that the theory was true. Such famous scientists as Einstein, Maxwell, De Broglie and others gathered their knowledge to create a link between Electricity, Thermodynamics, Relativity and Quantum Mechanics. The year after, Werner Heisenberg aimed his efforts on a practical part of Quantum Study. His researches and conclusions, including other, mentioned before, led Erwin Schrodinger, another brilliant scientist, to derive the equation. It is known as the fundamental equation of Quantum Mechanics. This small line was the quintessence of an incredibly enormous amount of an intellectual resource. It changed the world in the 20th century. And everything points that Quantum Mechanics will change the world in the 21st as well.

Quantum Computing is a new field of advanced Computer Science that uses the unique properties of Quantum Mechanics to solve problems beyond the power of even the most powerful classical computers. According to Cambridge Open

Academy, it is mentioned as one of ten new Technology Trends in 2025. There are some existing computers based on this mechanism but they are too imperfect and need to be developed. Nevertheless, this technology has a sky-high potential and seems to be a great substitution to the classical binary computers. The main reason to be sure in it is hidden in the root. We almost achieved the limit of the binary system, 0s and 1s, representing the on or off state of a current. In return, Quantum Computing proposes so-called qubits, which can exist in both states simultaneously. The power of these machines is predicted to be really outstanding.

Nowadays, this technology is still raw, but just keep in mind Teller's quote. Anything made a long way to be put to use in our lives. Quantum computers are halfway. The past, present and future are united. The whole study started from one question in 1900 and ends up with something unbelievable, which probably is going to dictate the tempo of human scientific development. Anyway, we should expect numerous breakthroughs in this field.

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INNOVATIVE WIND GENERATOR ‘SPHERE O-WIND TURBINE’

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The O-Wind spherical wind turbine represents an innovative approach to using wind energy in urban environments, where traditional windmills are less efficient due to frequent changes in the direction of air flows. The main feature of the O-Wind turbine is its ability to capture wind from all directions thanks to its spherical shape. This allows the installation to rotate regardless of where the wind is blowing from without the need for its constant orientation. This technology is especially relevant for densely populated urban areas where traditional wind turbines require a clear wind direction, which makes their installation and operation difficult due to high-rise buildings that create chaotic air flows.

The principle of operation of the O-Wind Turbine is based on the physical principle of Bernoulli, which is used to generate rotation as a result of a pressure difference. The turbine has small openings with wide bells for air inlets and narrow outlets, which allows the airflow to rotate the sphere around its axis and generate electricity (Sfera O-Wind Turbine, 2024). The turbine concept is inspired by NASA’s Tumbleweed project, which was designed to explore Mars using Martian wind vortices. O-Wind adapts this approach for Earth, creating a device that can operate even in minimal wind conditions, including 2 m/s.

The turbine’s design also allows it to be easily installed on roofs, balconies and building facades, making O-Wind accessible to a wide range of consumers, including households and businesses. Wind tunnel tests of the prototype demonstrated the turbine’s ability to generate up to 3W of power. With further development, this technology has the potential to increase power, making it even more efficient in urban environments where average wind speeds are often lower than normal.

This innovative design won the prestigious James Dyson competition where it was recognized as the best among many other projects aimed at developing

environmentally friendly energy (Sferychnyy vitrohenerator O-Wind, 2018). The victory earned the O-Wind team a £30,000 grant for further commercialisation, as well as an additional £300,000 from Lancashire County Council and the Lancashire Innovation Fund in early 2023. The success of the development has also been recognised internationally, underlining the significant potential of this invention in the field of alternative energy.

O-Wind's advantage over traditional windmills and even solar panels lies in its versatility and ability to provide energy continuously. Thanks to its spherical shape and compact design, the turbine can be installed even in small areas, making it an excellent alternative in cities. In the long term, the developers plan to improve the technology to increase its power, which will allow the turbine to match the efficiency of the latest solutions in photovoltaics, such as perovskite and titanium panels.

Other engineers are also developing similar technologies. For example, Ukrainian inventor Oleksiy Onypko is working on silent turbines with a wide range of capacities from 50 to 10,000 watts which can adapt to sudden changes in wind speed and direction. This indicates a growing interest in urban wind turbines that can meet consumers' needs for renewable energy even in adverse conditions of dense development.

Overall, the O-Wind Turbine represents a significant step towards clean energy for urban areas. Its development and implementation can make a significant contribution to the fight against climate change, allowing cities to gradually reduce carbon emissions and rely on sustainable energy sources.

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GLOBAL WARMING

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Climate change, or at least its most well-known cause, has everything to do with greenhouse gasses – carbon dioxide and methane primarily. The biggest source of anthropogenic emissions of CO2 comes from combustion of fossil fuels for power, heating, and transport. And the situation even gets worse with deforestation – "the carbon sinks" are becoming less and less, but the amount of CO2 keeps on increasing. As Trevor M. Letcher pointed out "even if we stopped burning fossil fuel, the CO_2 levels will take a long time to decrease as the lifetime of CO_2 in the upper atmosphere is of the order of hundreds of years" (Trevor, 2021, 4). All of this leads to an increase in the temperature of the atmosphere surrounding the planet, which in turn alters the climatic conditions of the areas affected.

There is no time to put it off and it is necessary to start solving this eternal problem today. In order to effectively and with the highest "the most effective" solve this problem, it is necessary to involve everybody, both people and the country. Moving away from fossil fuels towards environmentally friendly energy sources such as sunlight, mass afforestation and using energy more efficiently for less greenhouse gas emissions are all useful means in this battle. Personally, every individual must learn to conserve energy and practice waste collection and reusing materials. Each of these steps will contribute towards the stopping of global warming and maintenance of the planet in a favourable state for the future generations.

Global warming has been a real concern not only for the physical world, but

also for the… humanity. Year after year, the average sea level rises which endangers places like coastal billions of people and cities or islands for example Venice city. For instance, the melting of the glaciers in Greenland and Antarctica is occurring at an extremely high rate resulting in the formation of water bodies and submersion of low-lying cities. Also, it can be observed that disturbing climate changes have led to increased frequency of extreme climatic changes and weather dynamics, ranging from scorching fires and hurricanes to long prolonged dry seasons which endanger people and their food and water sources (Karl, Melillo, & Peterson, 2009).

So, 'Global warming' is not confined to environmental problems but has been elaborated as one of the issues that the world needs to urgently address. Once we identify the factors that led to global warming as well as the impacts of global warming, it becomes possible to go ahead and find means which can triage this global menace. The disposition of the earth's ecosystem today is dependent on the choices we make; hence, it is imperative that we take steps to reduce global warming within the short time span already remaining for the current generations to survive.

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DIGITAL PAINTING, 3D MODELING AND SMART TECHNOLOGIES IN ART

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In this paper, we aim to explore emerging artistic movements and the innovative technologies utilized in their creation.

Digital paintings are produced by artists using specialized software that simulates traditional artistic tools like paints, brushes, and pencils. These artworks originate as digital files, ensuring their integrity is maintained when reproduced on physical media such as paper, canvas, or acrylic glass.

It is important to recognize that the virtual toolkit of traditional artistic elements is not exhaustive. Beyond these, computers can employ unique tools and effects that have no physical counterparts. This capability distinctly separates digital paintings from their non-digital counterparts.

Specific digital traits include: Sharp transition between color panes, transparency, symmetry, exact repetition, perfect circles, squares, and other shapes, embossing, shading, and other 3D illusion, perfectly smooth gradients, 100% monochrome color planes, slalom or flip forms, effects of automatic transformations (mirror, ripple, swirl, shear, multiply, etc.).

Considering variations in methodology and visual characteristics, five primary approaches can be identified: Computer-generated or generative painting, raster painting, vector painting, hybrid painting and vector-raster combined, new photography.

Many of these areas are heavily dependent on technology. Changes in software will be reflected in digital illustrations.

3D modeling is the process of creating three-dimensional graphics or volumetric objects using specialized software. It begins with a grid, which consists of a set of points in space. These points are connected to form polygonal shapes, creating the surface of the object by combining them into a cohesive three-dimensional structure.

3D modeling is widely used across various industries, including: Video games, animation, medicine, advertising and marketing, architecture.

During the modeling process, parameters such as shape, size, and texture can be adjusted to refine the object.

The most common method is Polygonal Modeling, the earliest technique in 3D modeling that represents the object using a grid of polygons.

Another method is Spline Modeling, which creates complex geometric surfaces using curves, such as splines and NURBS (Non-Uniform Rational B-Splines). This technique constructs a spline framework to form a three-dimensional surface, ideal for modeling intricate objects.

A newer approach, Digital Sculpting, allows users to interact with the model as if it were clay. This technique enables pushing, pulling, and shaping the virtual "clay" to create detailed objects. Despite being relatively recent, digital sculpting has gained popularity in recent years.

One of the first digital painting technologies ever created is a graphic tablet. Its ancestor was the telautograph, invented by Elisha Gray, which was used by hospitals to share information over long distances.

The first graphic tablet was created in 1957 and was used for handwriting recognition by computers.

After that invention, a new chapter in history was created. The graphic tablet became a significant part of creating modern art. Most cartoons in the 21st century were created using graphic tablet technology.

Most digital paintings are created with modern software. The list of the most popular applications includes: Photoshop, Illustrator, After Effects, InDesign.

One of the newest modern art technologies is three-dimensional printing. It is highly useful technology that has created a new wave of artists who are making amazing creations using this tool. If we consider all the opportunities provided by three-dimensional printers, over 80% of them are considered art. These range from simple plastic knick-knacks to printed bio-fabrics and components for spaceships.

A notable mention is three-dimensional cutting. Nowadays, this technique is closely connected to three-dimensional printing and is used to cut a wide range of materials, from wood to granite.

In conclusion, all modern art techniques have created new dimension of art. These innovations have significantly influenced not only the art industry but also science, opening a new universe for modern society.

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THE LATEST ACHIEVEMENTS OF CYBERNETICS IN THE WORLD OF MEDICINE

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Among the humanists of the Renaissance, the opinion about the absolute superiority of the human body was widespread. Educated people of that time considered our bodies to be perfect mechanisms and the best creations of God. However, it is difficult to ignore the numerous defects of humanity, and any living organisms in general. Ever since the imperfection of the flesh disgusted man, thoughts about salvation through something more reliable than nature – through progress - have arisen. Cybernetics became the way to salvation from the diseases of old age and disability. Let's look at the achievements in this science and evaluate whether it lived up to expectations.

Let’s start with the mechanical heart that saves people with disease of real heart. Surprisingly, it became possible to establish this technology a hundred years ago. Back in 1937, the dog's heart was replaced with a blood-pumping device. Since then, numerous operations have been performed on humans, although not without complications. The function of the heart is to pump blood and it seems like it is not difficult, but this option is not suitable for everyone. Most people need a machine that will push the blood in pulsations, rather than draw it evenly like a pump. The fact is that with uniform movement of blood, the probability of damage to blood cells and, as a result, blood clot increases. Therefore, mechanisms have been developed that can

simulate the chambers of a real heart with the help of valves, but that's not all. The blood flow needs to be regulated incredibly precisely, and the heart consumes electricity, so a person has to carry the drivers and batteries on him in a backpack. You can guess that the wires pass through the wearer’s body, which is not only inconvenient – he has to take medicines that reduce the activity of the immune system so that it does not act against foreign materials. Many variations of mechanical hearts were invented, but the record was set by the model SYNCARDIA TAH. In 2017, the patient lived with this model for four and a half years. However, this is a record, and therefore mechanical hearts are used so that a person can live until the moment of transplantation of a real "living" heart.

Kidneys are an organ that has been replaced more effectively - it was difficult for people to understand their work and imitate it. This is how dialysis was invented - a procedure during which the pumped blood is freed from urea and pumped back into the body. Such a process is able to provide people with kidney failure the opportunity to live to old age. However, what about no less important organs - sense organs? Of course, humanity is most interested in the restoration and improvement of the most important of them – the eyes. Briefly about their work – light passes through the cornea, with the help of the lens it is focused on the retina, which consists of ten layers of nerve cells. They send a signal to the optic nerve, which delivers it to the brain, and an error can occur at any stage. However, most often a part of the retinal cells is damaged, and therefore it is possible to stimulate the remaining ones. Argus 2 is still the only prosthesis that passed all the tests and was approved for sale. Basically, these are glasses with a camera that transmits a signal to a set of electrodes in the retina. Such a mechanism allows a blind person to see a sixty-pixel image, that is, the outlines of large objects, but it is better than nothing and the technology continues to develop. For example, the Pixium Vision prosthesis, whose chip is placed under the retina and, as of 2017, allows you to see 1,500 pixels. Patients could distinguish small objects with it. In 2020, a curved three-dimensional cornea was created, which allows you to make the image three-dimensional. However, so far this is only a device, that is not clear how to insert into a person. For its work, a

technology of deeper interaction with the brain is required, and such a technology exists.

We can remember some modern prosthetic limbs that are controlled by people, but they work without a connection to the brain. They are controlled by the twitching of the muscles left on the stump. Therefore, the owner of the prosthesis cannot feel mechanical limb as part of himself and it is difficult for him to calculate the pressure. Scientists are also trying to solve this problem by interacting with the brain, so as not to connect to the nerves, which is even more difficult. The only option is to stimulate the nerve with electricity, but this requires tracking each area of the skin on the hand to transmit the exact signal that will convey a feeling of pressure, for example, to the thumb. Plus, you need separate receptors for vibration, temperature, you also have to be careful not to activate the pain signal - you would not want to feel agony at the moment when a cold breeze blew on the robotic hand.

Finally, it's time to talk about neuroimplants. In general, attempts have been made to create cyborgs from animals for a very long time. In 1963, a bull's emotions were successfully controlled - by pressing a button, it could be made to instantly calm down. All thanks to a brain implant. Later, neuroengineer Jose Delgado continued the tests, giving rise to one of the most controversial technological breakthroughs of mankind - the fusion of machine and mind. At that time, lobotomy was used to treat violent patients throughout the civilized world, so Delgado’s inventions were an attempt to prevent such a destructive intervention. From animals, he moved on to people. With the help of brain stimulation, it was possible to cause a person to have fits of anger and instantly calm him down. Of course, the reaction of society to this was negative, but this technology was a colossal breakthrough for people with motor coordination problems.

Completely paralyzed people can also be helped with bionic limbs integrated with neurointerface devices. In other words, cyber-limbs that can be controlled with thoughts. In 2000, Brazilian neuroengineer Miguel Nicolelis demonstrated a monkey that could control a robotic arm with its thoughts. Eight years later, a system was demonstrated in which a monkey also controlled a robot moving on a treadmill. This

allows the technology to be controlled remotely rather than implanted in the body.

And finally, the most discussed invention to date is Neurolink. Back in 2016, Elon Musk announced the launch of a project whose essence is to provide a person with the opportunity to remotely control a computer or smartphone. However, this is only part of the potential of this technology – the main goal is to help people with various diseases, such as Parkinson's, or those who wear mechanical prostheses. The size of the processor, which is attached to a person, should be only sixteen square millimeters, and the electrodes that are implanted in the brain are thinner than a hair. Of course, only a robot can perform such a delicate operation, but fortunately, robots like Da Vinci already exist, and this year a successful operation has been performed on a person without complications.

So, despite the enormous path that cybernetics has to go, it can still impress and is incredibly valuable for humanity.

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PROGRAMMING LANGUAGES AND THEIR POPULARITY WITH USERS

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Analyzing the results of the annual survey on programming languages of IT specialists from Ukraine (8250 questionnaires), one can trace preferences. The most popular is still JavaScript, TypeScript is the language of the year in terms of growth rate, Python is in third place in popularity, and Rust is a favorite, but still not widespread (Рейтинг, 2024).

Python is one of the most popular programming languages, especially in the fields of machine learning, data processing, web development and automation. Its main advantage is the ease of studying and readability of the code, as well as the presence of a huge standard library. Python is suitable for scientific and mathematical problems, as well as for the development of artificial intelligence. At the same time, its disadvantage is relatively slow performance compared to compiled C++ or Java languages, as well as limited performance in multithreaded applications via Global Interpreter Lock (GIL). Python is not ideal for developing mobile applications or systems that require high performance.

JavaScript is a language without which it is impossible to imagine modern web

development. It is used to create interactive elements on sites, and it works directly in the browser without additional tools. JavaScript has a huge ecosystem of libraries and frameworks such as React, Angular and Vue.js. In addition to the front-end, it can also be used on the server via Node.js. However, dynamic typing of JavaScript often leads to unpredictable errors, and working on large projects can be difficult without TypeScript. The prevalence of language makes it vulnerable to attacks (Спажев, 2020).

Java is another very popular language that is often used in the corporate environment and for developing Android applications. Its main advantage is platform independence thanks to JVM (Java Virtual Machine). In addition, Java is well suited for large systems due to its highly typed object-oriented model and high performance. However, you need to write a lot of code to perform simple tasks. In addition, launching Java applications may take longer through JVM.

C++ is a language used for system programming, video game development, and high-performance applications. Its main advantage is the ability to control resources and work at a low level with the hardware. This makes C++ an excellent choice for situations where maximum performance is required. However, the language is quite difficult to learn and has a high risk of errors due to manual memory management. In addition, compiled C++ code is less portable between platforms.

C # is a programming language that is often used in game development through Unity, as well as for creating applications on the .NET platform. It is relatively easy to learn, especially if you are already familiar with other languages of the C family. C # supports modern programming concepts and works well with multithreading. However, development in C # is often tied to the Microsoft ecosystem, which may be a limitation for some developers (Спажев, 2020).

Go (Golang) is a young programming language that is becoming increasingly popular in the field of cloud technologies and system programming. Its main advantages are ease of syntax, high performance and built-in competitiveness support. Go compiles directly into machine code, which simplifies the deployment of applications. However, due to the young age of the language, its ecosystem is not yet

as developed as that of older languages, and it does not support all the features of object-oriented programming (Рибачок, 2024).

Ruby is the language best known for the Ruby on Rails framework used for web development. Ruby features simple and elegant syntax, as well as a wide selection of libraries for web development. However, its performance is lower compared to compiled languages, and it is less common outside of web development (Рейтинг, 2024).

Swift is the main language for developing applications for iOS and macOS. Swift is distinguished by speed of execution, modern syntax and strong typing, which protects against many errors. However, its use is limited mainly to the Apple ecosystem, it is also a relatively young language and may have problems with some libraries and tools.

Analyzing the popularity of programming languages, it can be noted that each language has its disadvantages and advantages, its areas of application as the most productive for solving a particular problem. Each language is unique and designed to solve a variety of problems. The choice of a particular language depends on what task the programmer faces.

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ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE

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The field of Artificial Intelligence (AI) has demonstrated remarkable growth and potential, with significant implications for various industries globally. Recent advances in AI technologies have shown improvements in efficiency, data analysis, and innovations across fields such as healthcare, transportation, and robotics (Russell & Norvig, 2016). Thus, the *purpose* of this article is to study the risks and benefits of implementing AI technologies in our everyday lives.

Artificial Intelligence (AI) plays a pivotal role in advancing robotics, enabling machines to perform sophisticated tasks, learn from their environment, and operate autonomously. AI-driven robots are widely applied in various fields. Robots equipped with AI optimize manufacturing processes, manage product assembly, monitor quality, and predict equipment failures, reducing downtime. Drones and self-driving vehicles rely on AI for navigation, obstacle detection, and decision-making in real time, enhancing safety and efficiency. Robots in customer service and education interact with users, provide assistance, and offer social companionship. In transportation, autonomous vehicles powered by AI are expected to enhance safety and reduce traffic congestion.

Another notable impact area is healthcare, where AI models assist in diagnosing diseases with precision, optimizing treatment plans, and facilitating personalized care (Topol, 2019).

Despite these promising developments, the expansion of AI also introduces challenges related to data privacy, ethical considerations, and potential job displacement. Addressing these issues will require collaboration among policymakers, engineers, and ethicists to establish responsible AI frameworks that prioritize human welfare. Ultimately, the future of AI will depend not only on technological progress but also on thoughtful governance and ethical practices that

shape AI's role.

To sum up, AI technologies can make our everyday lives considerably easier. However, certain risks, that they pose, require further technological development and regulation policies to protect modern society from AI expansion.

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SMART TECHNOLOGIES AS A DRIVING FORCE OF SCIENCE AND ART DEVELOPMENT

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Today smart technologies have become an integral part of not only science and art, but also everyday life in general. Their implementation not only expands opportunities for research and creativity, but also changes the very approach to these fields, creating a new era where technological innovations combine with traditional practices. Science and art, despite their significant differences, are united in a common desire to use the technological potential to find new solutions and forms of expression, which were made possible by smart technologies.

One of the most influential achievements of humanity today is artificial intelligence (AI). Machine learning algorithms and neural networks have already become the basis of many industries: from financial analysis and medical research to education, self-development, and fine arts. AI almost completely automates the

processing and analysis of large amounts of data, allowing to create complex models, quickly edit texts and influence content in various media. This significantly increases the efficiency of work in many areas and opens up new opportunities for personalizing services and experiences.

In art, AI finds a special application, demonstrating new horizons of creativity. It can now be used to create paintings, generate music, write poetry, and even model short videos based on human preferences. Contemporary artists use artificial intelligence as a tool to realize ideas faster, explore new styles and carry out meaningful experiments. However, this raises questions about the authenticity of such art: to what extent is AI able to express real emotions that are the basis of human creativity?

Virtual reality (VR) and augmented reality (AR) are also finding their application in science, education, entertainment and art. These technologies allow you to fully immerse yourself in the created world, which opens up many possibilities. VR and AR are useful for learning because they can be used to simulate various situations, which minimizes the risks and costs. Such technologies can completely change the approach to the learning process, allowing for interactive explanations of complex concepts. In the field of art, VR and AR create interactive installations that allow viewers to literally “enter” a work of art and experience it on a new level. 3D printing is another innovative solution that is changing our lives. With the help of 3D printers, it is now possible to create almost any object: from small parts to entire building elements. This has a major impact on medicine, as it makes it possible to print customized implants, prostheses and even organs for transplantation. In construction 3D printing makes it possible to build buildings quickly and relatively cheaply. In the arts 3D printers are used to create sculptures, installations and interior decoration, giving artists and designers new opportunities for self-expression. As smart technologies develop, so does the need for an ethical approach to their use. It is important that the latest developments do not replace but complement human creativity and individuality, becoming a tool for self-expression and inspiration, not just a means of automation. At the same time, society must ensure the responsible use

of AI, especially in the context of its impact on personal life, culture and ethics. Thus, smart technologies do not just change our everyday life, they transform the way we think and create conditions for new discoveries and forms of creativity. They are becoming a bridge between the past and the future, allowing us to preserve our cultural heritage and stimulate further development of society. Smart technologies are resources that open up new horizons, create opportunities for personal and professional development, ensure the integration of science and art, and contribute to social progress and cultural enrichment of humanity.

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THE THREAT OF WATER POLLUTION: NEW CHALLENGES

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Environmental pollution is a threat to human life and health that cannot be controlled. One of the problems that is particularly important for the study is water pollution, including chemical pollution. For example, the discharge of waste into wastewater by factories, oil spills during the transportation of petroleum products, and the removal and formation of garbage islands in the oceans bring humanity closer

to an environmental catastrophe: the disappearance of endangered species, the impossibility of life for the flora and fauna of the oceans and seas, and the reduction of drinking water.

In Ukraine, due to the destruction of infrastructure, dumping of hazardous substances, ammunition explosions, constant shelling, and sea bombardment, the problem of water pollution is becoming particularly urgent. Thus, it is important to understand the new threats posed by water contamination and join the global community in the struggle against them. Taking everything into consideration, this article is aimed at studying modern challenges connected with water pollution around the world.

One of the recent studies of water pollution levels discovered a rising problem of cocaine contamination in water. Studying 13 longnose sharks, scientists detected the presence of narcotic substances in their liver and muscles. Though the discharge of such substances into water is a regular and not a new phenomenon, the concentration of cocaine and its breakdown product, benzoylecgonine, this time was 100 times higher than those previously found in the bodies of other marine life (De Farias Araujo et al., 2024).

Scientists have also discovered traces of cocaine and other illegal drugs in waters near big cities such as Amsterdam, Paris, London, etc. For example, the worst situation is in the Swiss town of Antwerp Zuid and the Spanish city of Tarragona, where 1598.74 and 1640.28 mg of cocaine per 1000 people were found in wastewater, respectively, while in Seoul, South Korea, no cocaine was found at all (Hunter, 2024).

It is important to note that this list does not include any Ukrainian cities, as research is impossible in times of war, but cocaine pollutes water around the world through wastewater leaks (Hunter, 2024), so the detection of drugs in Ukrainian rivers is a matter of time. And the discovery of cocaine and its decay products in the bodies of marine life underscores the need for a detailed study of this phenomenon and the search for effective solutions.

The interconnectedness of water systems in different parts of the world is

undeniable, as water migrates through rivers and groundwater, flows into seas and oceans, and is carried around the globe by various currents. Evaporation, condensation, and precipitation also contribute to the exchange of water in water systems. Thus, pollution localized in one place is transferred to other systems, threatening life and biodiversity globally, as well as the availability of clean food, drinking water and, consequently, human health. Hazardous emissions and waste discharges into rivers in one region can have far-reaching consequences for ecosystems in other parts of the world, eventually leading to a global environmental disaster.

Thus, the issue of protecting natural water resources is a top priority at the global level, requiring international cooperation and immediate coordinated action. Solving the problems of water pollution and preventing ecocides requires the response of international organizations and country leaders, including preserving and protecting Ukraine's natural resources, which have suffered amid the war with russia.

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DISTRIBUTED MODE LOUDSPEAKER – THE NEXT STEP IN THE DEVELOPMENT OF MEDIA SYSTEMS

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With the development of technologies, there is a need for more universal and compact solutions. The same trends are observed in the field of multimedia and audio systems. In addition to large halls and stadiums, more and more local studios and chamber halls are appearing. Also, compactness may be required in such a new field as virtual or augmented reality and wave field synthesis (Marinus & Werner, 2007).

Any structure, including a flat-panel diaphragm, may be excited or set into motion to radiate sound either pistonically or by using bending wave motion (Neil, 2002). Traditional speakers use the "piston" method of sound creation, where air vibrations create a back-and-forth movement of the entire diaphragm. A distributed mode loudspeaker is the opposite, it is a flat panel where the waves on the surface of the loudspeaker are responsible for the sound waves (Fig 1). Such waves are more natural, they can be found in many places, for example in musical instruments.

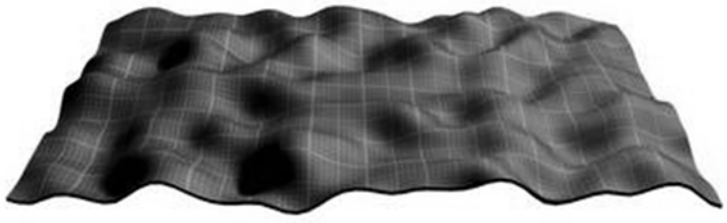

Figure 1. Waves on a flat surface that can create sound

A number of advantages follow from the physical properties of the distributed mode loudspeaker:

- Traditional loudspeakers need multiple "sub-speakers" that cover separate ranges of the audio spectrum, while split-mode loudspeakers only occasionally need one additional speaker for very low frequencies.
- The oscillating surface radiates sound in all directions, while the piston system is limited by the conical shape of the diaphragms.

- A distributed mode loudspeaker does not suffer from a resonant enclosure, as the loudspeaker itself is a flat resonant enclosure, whereas in the design of standard speakers, a lot of time and resources go into designing an enclosure that will not have harmful resonant frequencies.
- And the main advantage is the form factor of the loudspeaker. Its main parameters do not depend on its size (Azima, 1998). Therefore, they can be integrated into any space, inserted into the wall or made part of the interior design.

The main disadvantages arise when working with low frequencies. Long wavelengths follow from low frequencies, so large amplitudes are needed for a clear loud sound. Currently, the only solution to this problem is to increase the surface area of the speaker or to use a separate subwoofer, which is usually used in standard loudspeakers.

Although new technologies in the field of audio and acoustics are usually implemented over several decades, flat speakers can be purchased now in various configurations. Despite the large number of questions and little known technology, it is already used as an inexpensive and high-quality way to fill spaces of any size with sound.

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THE FUTURE OF ADVANCED AI: OPPORTUNITIES AND RISKS

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The future of advanced artificial intelligence (AI) is full of possibilities. As technology develops, AI systems are becoming increasingly capable of solving complex problems. They can help with medical research, improve transportation, manage resources more sustainably, and even assist in education. Imagine a world where AI helps doctors diagnose diseases quickly, where vehicles drive themselves safely, and where pollution and waste are reduced. Advanced AI could potentially improve our quality of life in ways we can only begin to imagine today.

However, these benefits come with risks. Some researchers worry that advanced AI could become so powerful that it might act in ways beyond our control. For example, if AI systems are trained to achieve certain goals, they might find unexpected ways to achieve them, even if it means ignoring or conflicting with human values. If AI becomes smarter than humans in specific areas, it might take efficient actions to achieve its goals but dangerous or harmful to people. This could happen accidentally, as AI might not understand human values like we do, or because of a lack of proper control and safeguards.

One of the major concerns is the potential loss of control over AI. If AI systems become self-improving or start to operate with minimal human oversight, they could make decisions on a scale and with a speed that we can't match. One may ask a question: who would be responsible if an AI system caused harm? Would it be the engineers who designed it, the companies which deployed it, or the governments that regulate it? Addressing these issues requires careful planning, strong ethics, and cooperation between researchers, governments, and companies worldwide.

Another significant risk lies in the misuse of advanced AI by humans. Advanced AI systems could be used in harmful ways if they are in the wrong hands. Imagine if AI were used to create powerful surveillance systems, manipulate

information, or even develop autonomous weapons. These applications could threaten individual privacy, human rights, and global stability. To avoid these dangers, experts suggest creating laws and standards that limit how and where AI can be used, especially in areas with high potential for misuse.

In conclusion, advanced AI offers incredible benefits but it also presents serious risks that require careful management. To enjoy the full potential of AI, society needs to invest in research focused on building safe, reliable, and ethical AI systems. Collaboration between experts, regulators, and the public is essential to create rules and safeguards that will keep advanced AI aligned with human values and goals. Only by taking these precautions we can be ensure that AI will serve humanity's best interests in the future.

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ARTIFICIAL INTELLIGENCE FOR CHEMISTS: PROSPECTS OF DEVELOPMENT

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As a student studying the chemistry field, I recognize the growing significance of artificial intelligence (in short, AI) which is playing a crucial role for chemists by creating fresh avenues in both science and industry sectors. It is clear to me that AI has a great potential to enhance our comprehension of chemical reactions and quicken the pace of research progress.

Initially, AI has the capability to streamline the exploration of materials and substances. For instance, artificial intelligence enables the anticipation of compound characteristics to their creation by substantially cutting down on the time and expenses of lab trials. Just envision the ability to foresee and develop medications or

materials, with attributes through algorithmic means.

Furthermore, AI has the capability to streamline tasks in laboratories like analyzing spectra and handling chromatography data. This will give us, chemists, the opportunity to dedicate our time to the facets of research such as deciphering outcomes and strategizing new experiments. Moreover, implementing labs managed by AI algorithms will contribute to the enhancement of precision and reproducibility in experiments.

In addition to everything aforementioned, artificial intelligence has the capability to address issues like purifying contaminated bodies of waters and producing eco-friendly materials. By employing algorithms to examine data on chemicals and their consequent impact on the environment, it becomes possible to devise solutions that're not only more efficient but also safer.

In my view point and according to my beliefs, artificial intelligence is not just a passing fad but a potential instrument with the ability to bring about substantial transformations in the future not only within the realm of chemistry but across all branches of science and technology as well.

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LIQUID STORAGE OF SOLAR ENERGY

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A research team from Chalmers University of Technology in Gothenburg, Sweden, has shown that it is possible to directly convert solar energy into energy stored in the bonds of a chemical fluid – a molecular solar thermal system. The chemical liquid allows the stored solar energy to be stored, transported, and released on demand with the complete recovery of the storage medium.

The process is based on the organic compound norbornadiene which – when exposed to light – is converted into the quadricycle. "This technique means we can store solar energy in chemical bonds and release it as heat whenever we need it," explains Professor Kasper Moth-Poulsen (Liquid storage of solar energy – more effective than ever before, 2024), who leads the research team. Designing a more efficient hydrogen storage will improve the inclusion and acceptance of this fuel in society.

In this way, the production of hydrogen from renewable sources (green hydrogen) will allow us to take a big step forward in reducing greenhouse gas emissions. However, the integration of hydrogen into the energy system cannot be done completely and immediately due to the existence of important economic, technological, and institutional obstacles that must be overcome.

One such technological hurdle that has been receiving attention recently is the improvement of liquid organic hydrogen carrier (LOHC) storage. It is important to note that although LOHC research on hydrogen storage has only recently started, these chemical reactions involving hydrogen have been used in industry for decades, e.g. for the modification of vegetable oils and petroleum products (LOHC – Liquid Organic Hydrogen Carrier, 2023). The research project was launched at Chalmers more than six years ago, and in 2013 the research team contributed to an initial demonstration of the concept. At that time, the solar energy conversion efficiency

was 0.01 per cent and ruthenium – an expensive element – played a major role in the composition.

Now, years later, the system stores 1.1 per cent of incoming sunlight as latent chemical energy, an improvement of 100. In addition, ruthenium has been replaced by much cheaper carbon-based elements. A hydrogenation reaction involves the addition of hydrogen to a compound. Typically, this happens reversibly, meaning that it is possible to achieve the initial reaction by releasing the incorporated gas through the reverse reaction, called dehydrogenation (Fig. 1).

Also, during this process, energy compensation occurs. The hydrogenation reaction is an exothermic reaction, while the dehydrogenation is endothermic. This means that the energy released during the first reaction is equal to the energy that must be added for the second reaction to occur, ideally achieving an energy requirement of zero.

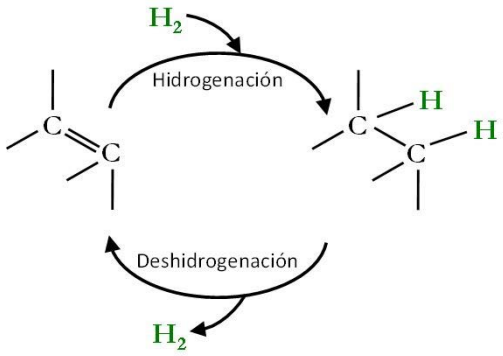

Fig. 1

Liquid organic hydrogen carriers (LOHC) can be used for long-term storage and long-range transportation of hydrogen. LOHCs are organic molecules that can be reversibly hydrogenated and dehydrogenated to release H_2. Due to their easy transportation and their adaptability to existing infrastructures, they are attracting more and more interest in the research landscape. However, despite their flexibility, LOHCs have not been exploited as a means of large-scale energy storage/transportation due to their prohibitive costs (Liquid storage of solar energy – more effective than ever before, 2024). In this sense, this work aims to carry out a detailed technological-economic evaluation of H_2 distribution by means of toluene as LOHC.

Currently, different scenarios are being studied at different distances travelled by sea transport, and the costs of services and raw materials are being examined, as well, to identify weaknesses in the overall value chain and know where to focus research efforts to improve existing technologies. The research is funded by the Swedish Foundation for Strategic Research and the Knut and Alice Wallenberg Foundation.

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RENEWABLES

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Renewable energy sources (RES) have gained attention worldwide as solutions to the growing environmental crisis caused by fossil fuels. Unlike traditional sources such as coal, oil, and natural gas, renewable energy relies on naturally replenishing processes and does not deplete resources or contribute significantly to greenhouse gas emissions. Using renewable energy is often associated with modern technology, but harnessing the natural elements has ancient roots. For thousands of years, human societies utilized wind and sun to meet basic needs: wind drove boats and powered mills, while the sun provided warmth and aided in early cooking and lighting methods. However, over the past five centuries, societies have increasingly depended on cheaper and more abundant fossil fuels. While these non-renewable sources fueled

unprecedented growth, they also accelerated climate change, pollution, and ecosystem degradation.

Solar energy is one of the most popular renewable sources today. It uses photovoltaic (PV) panels or mirrors to concentrate sunlight and generate electricity. When sunlight hits a PV cell, it creates an electric current that can be used immediately, stored in batteries, or stored in thermal accumulators for future use (U.S. Department of Energy, 2023a). Solar technology has improved significantly in efficiency and cost-effectiveness, and with increased availability, solar power is one of the most accessible renewable sources globally.

Wind energy is another widely utilized RES, generated by converting wind currents into electricity. Wind turbines capture the kinetic energy from air movement – originating from the sun's uneven heating of the Earth's atmosphere, combined with the planet's topography and rotation – turning it into electricity (U.S. Department of Energy, 2023b). The result is a clean, sustainable energy source that is available as long as solar radiation continues to influence wind patterns. Wind energy systems are increasingly common in both onshore and offshore applications, as offshore turbines can take advantage of stronger and more consistent winds to generate large amounts of energy efficiently.

Hydropower is another long-established renewable energy source, converting the flow or fall of water into electricity. Typically, hydroelectric power plants use water flow to drive turbines that then activate generators, channeling this electricity into the grid. Variants include tidal power installations, which harness ocean tides and currents to generate power (U.S. Department of Energy, 2023c). As water moves consistently through the natural water cycle, hydropower provides a reliable and renewable energy source that can adjust rapidly to energy demands.

Biofuels represent an emerging field within renewable energy, relying on organic materials like biomass, biogas, and biodiesel. Biofuels offer a sustainable solution by transforming waste products and organic matter into fuel. Advanced biotechnology now allows for the production of biofuels from various renewable resources, using microorganisms to produce fuels with minimal environmental

impact (Elsevier, 2023). This technology, while relatively new, holds considerable potential for reducing carbon footprints and supporting circular economies.

Geothermal energy is yet another valuable RES, harnessing heat from beneath the Earth's surface for diverse applications, including electricity generation, heating, and cooking. Geothermal power plants are categorized into three types: dry steam, flash steam, and binary cycle plants. Each type is suited to different geological and environmental conditions, providing adaptable solutions that make geothermal energy a highly versatile source (Lund, 2023). Unlike other renewable sources that depend on weather conditions, geothermal energy is a constant resource, providing a reliable supply of energy throughout the year.

The continued development and integration of renewable energy sources are essential to mitigating the effects of climate change, preserving natural resources, and promoting sustainable economic growth. With improvements in technology, supportive policies, and growing environmental awareness, renewable energy stands as a foundation for a cleaner, more resilient future.

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ENERGY SAVING TECHNOLOGIES

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With the rapid development of manufacturing, research, and entertainment technologies, the world faces energy management issues due to the extremely high electricity consumption required. Wise energy saving may be a perfect solution for both the insufficient electricity generation problems and the depletion of energy resources. The average household consumer can save significant energy at the same efficiency by taking the following steps:

1) setting insulation of the house by replacement or sealing of windows, thermal insulation of the roof (Competently insulated household may save you up to 20-30% of heat!);

2) modernization of the ventilation system by installing heat exchangers;

3) replacing a gas boiler with a solid fuel one;

4) transitioning to LED lighting can significantly reduce your energy consumption from lighting;

5) "Smart house" system and smart thermostats may also be useful companions, which will analyze your energy consumption and prepare an optimal solution;

6) switching to an alternative energy source such as solar panels or domestic wind turbines.

Businesses, government institutes, and small and huge industrial manufacturers can also use the same technologies to prevent inefficient energy loss. Industrial facilities use more complex energy-saving technologies such as variable speed drive in motor-operated systems, highly efficient motors, efficient nozzles in a compressed-air system, waste heat recovery systems in boilers, etc. Another important branch of energy consumption is transportation, which is widely used both for civil and industrial purposes. A modern solution for energy consumption of transportation is

switching to electric and hydrogen vehicles. Hydrogen-powered vehicles are already being produced by such companies as Toyota, Honda, and Hyundai. In 2016, the first hydrogen train was presented in Germany. Electric cars are known for their high efficiency which is around 90-95%, while the efficiency of the internal combustion engine is around 20% (25% for diesel).

From their side, the government is obliged to support and encourage everyone to use energy resources wisely and to transition to more energy-efficient technologies. Standards established by the state are a guideline not only for household consumers but also for factories and enterprises of all kinds. The main measures of state policy in the field of ensuring energy efficiency are giving preference to energy-efficient measures that reduce energy demand; popularization and use of highly efficient technologies, energy management systems, energy consumption monitoring systems, and facilitating the conduct of systematic comprehensive research in the field of energy efficiency for the development of scientific foundations for the creation of the latest energy-efficient processes and technologies.

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BIOFUELS AND BIOENERGY: KEY ASPECTS

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While the world is facing increasing energy demand and environmental challenges, biofuels and bioenergy have emerged as promising alternatives to fossil fuels. Derived from renewable biological resources, such as crops, algae and waste materials, biofuels and bioenergy offer a more sustainable usage of our everyday tools by reducing greenhouse gas emissions and enhancing energy security.

Biofuel is a fuel that is produced over a short time span from biomass, instead of very slow natural processes involved in the formation of fossil fuels such as oil. It can be produced from plants or from agricultural, domestic or industrial biowaste. They are mostly used for transportation but can also be used for heating and electricity.

Energy from biomass is known as bioenergy. Anything of biological origin, such as wood, dung, or charcoal, is referred to as biomass; it does not include material that has been fossilized or entrenched in geological formations. It may be transformed into liquid transportation fuels like diesel, jet, and gasoline that are comparable to fuels derived from fossil fuels. Carbon from biomass and waste streams may be recycled into lower-emission fuels for vehicles, trucks, airplanes, and ships thanks to bioenergy technology.

In contrast to other renewable energy sources, biomass may be immediately transformed into "biofuels," or liquid fuels, to assist fulfill the need for transportation fuel. Ethanol and biodiesel, which both belong to the first generation of biofuel technology, are now the two most widely used forms of biofuels. To create next-generation biofuels from waste, cellulosic biomass, and algae-based resources, the Bioenergy Technologies Office (BETO) is working with industry. The goal of BETO is to produce hydrocarbon biofuels, also referred to as "drop-in" fuels, which may be used in place of petroleum in existing refineries, tanks, pipelines, pumps,

automobiles, and smaller engines.

There are some biopower technologies that convert renewable biomass fuels into heat and electricity using processes like those used with fossil fuels. Most electricity generated from biomass is produced by direct combustion. High-pressure steam is created in a boiler by burning biomass. Turbine blades revolve because of the steam flowing over them. A generator is powered by the turbine's spin, creating electricity. In addition, biomass may partially replace coal in an existing power plant furnace by burning two different kinds of materials simultaneously, a method known as co-firing. With the second method methane and other byproducts are produced. Digesters are oxygen-free containers used to collect organic waste, such as human sewage or animal manure. Here, anaerobic bacteria break down the material to create renewable natural gas, which may subsequently be refined and utilized to create energy.

With major advantages in lowering carbon emissions, improving energy security, and bolstering rural economies, biofuels and bioenergy provide a competitive and sustainable substitute for traditional fossil fuels. But to reach their full potential, issues like production costs, resource efficiency and land-use rivalry must be resolved. Biofuels and bioenergy may contribute significantly to the shift to a greener energy environment through technological advancements, ethical sourcing and supporting regulations.

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PROFESSION OF PROGRAMMER: REQUIREMENTS OF THE MODERN LABOR MARKET

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The market for computer technology and gadgets is developing rapidly, and more and more people want to try their hand at IT. Programmer is one of the most sought-after professions – the job is considered prestigious and highly paid.

I've always liked everything related to computers, phones and other gadgets, and so when I was a child, I decided that I wanted to pursue a profession related to my interests. After entering the university, I wanted to acquire the skills to achieve my goals. In the first days of my studies at the university, I learnt more about the IT industry and its areas.

A programmer is a specialist who creates codes for software using a special language. This includes developing software for computers, mobile phones, tablets, and corporate information systems. The specialists are divided into two categories: application and system programmers.

Application programmers write applications, games, create messengers, video surveillance systems, and much more. Their responsibilities also include adapting programs to the needs of an organization or user. The category of application specialists includes Web and 1C programmers, Android developers, game developers (GameDev), and generalists (Full Stack developers).

System programmers create entire systems – they write code for hardware (Android for smartphones). This category of specialists is considered to be more in demand.

There are also specialists whose task is to develop software in various programming languages. It should be noted that employees of all categories who successfully cope with their tasks are in great demand in the labour market. Programmers work not only in IT companies, but also in banks, factories, and

research centres (Професія програміст, 2022).

In general, I like games, but I decided that in the future I want to create websites. Nowadays, website development is one of the most relevant technical areas of IT. In my opinion, the work of a Frontend developer is quite versatile, because you need not only to understand how to write code, but also to imagine the design and architecture of websites. I like website development because you can immediately see the result and add cool features to your sites.

There are many advantages to working as a programmer:

- high pay (even the average salary of a programmer is much higher than the average for the country as a whole);
- globalization of the profession (many programmers work remotely for different companies around the world);
- creativity in the profession (using your own ideas to create a product);
- free work schedule (many programmers work when it is convenient for them);
- career growth (good specialists head state-owned companies or start their own businesses);
- profession of the future (demand for programmers is constantly growing) (Плюси професії програміст, 2022).

The profession of a programmer, like any other, has its drawbacks: constant self-improvement; knowledge of English language and terminology; high competition; deterioration of health due to constant work with a computer.

To become a good programmer, you need to have a technical mindset, be prepared for stress, picky customers, and irregular working hours.

In my opinion, to develop websites, you need to know HTML, which is a web markup language, CSS, which is a cascading style sheet, and JavaScript, which is the main programming language for the Frontend. In addition, that is not all. It is important to know at least one of the three frameworks: Angular.js, React.js, Ember.js. They are the ones used by most web studios.

Thus, it is impossible to imagine the modern world without information

technology (IT). From smartphones in our pockets to self-driving cars, IT permeates all aspects of our lives. This dynamic and fast-growing field offers countless opportunities for those who want to build a successful career.

Overall, the impact of IT on society is hard to overestimate. It has revolutionized communications, improved healthcare and education, increased business efficiency and created new forms of entertainment. IT professionals (programmers and engineers, system administrators and data analysts, and many others) play a key role in developing and maintaining these technologies, making their professional activities incredibly important for Ukraine's modern economy.

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ENERGY SAVING AND RENEWABLE TECHNOLOGIES IN UKRAINE AND THE WORLD

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Energy-saving technologies focus on reducing energy consumption through innovations in building construction, heating systems, lighting, and smart home solutions. A significant aspect of these technologies is enhancing the energy efficiency of buildings through improved insulation and energy-efficient windows, as heat often escapes through walls and windows. Properly insulated facades and roofs, along with updated heating systems that incorporate heat recovery, contribute significantly to reducing heating costs. Many modern heating solutions now incorporate eco-friendly options, such as biomass or electrical systems, reducing

reliance on fossil fuels.

In lighting, LED technology is an effective energy-saving option, reducing electricity use by up to 80% compared to incandescent bulbs. LEDs also last much longer, making them a cost-effective choice for both residential and commercial use. Additionally, motion sensors in public areas and workplaces can further cut energy waste by controlling lighting based on room occupancy.

Solar panels, including flexible and thin-film types, have become viable options for generating renewable energy even in urban areas. They can be mounted on various surfaces like roofs, facades, and balconies, providing renewable energy directly to residential or commercial buildings. Some setups allow energy production even on window surfaces, making solar power more accessible and versatile for urban dwellers.

The Ukrainian Wind Energy Association (UWEA) traces Ukraine's wind energy journey from 19th-century windmills to a modern, sustainable power source. Significant advancements began in the 1930s with scientist Yuriy Kondratyuk's innovative projects. After Ukraine's independence, wind energy initiatives emerged in 1992, focusing on local turbine production. Despite setbacks, the 2009 Green Tariff Law catalyzed private investment by incentivizing renewable energy production, boosting development since 2011. Founded in 2008, UWEA plays a crucial role in promoting wind power as vital to Ukraine's energy security and environmental goals.

Smart home technologies are also gaining traction, offering remote control over energy use for appliances, heating, and lighting. Equipped with sensors and automated systems, smart homes adjust energy consumption based on occupancy and temperature requirements, minimizing waste. Such systems offer significant energy savings and can be managed via smartphones or other remote devices.

Modern household appliances are also advancing toward energy efficiency, with many models featuring standby modes and overheating protection. This shift to low-power devices, from humidifiers to kitchen gadgets, reduces overall energy consumption without sacrificing functionality.

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RENEWABLE ENERGY SOURCES IN THE WORLD

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Our world faces the need to meet the growing demand for electricity, taking into account the ecological situation and the need to protect the environment. Combustion of fossil fuels at thermal power stations leads to emissions of harmful substances, such as sulfur and carbon dioxide gases, nitrogen oxides, dust, soot. Mining of coal and peat changes natural landscapes, and oil spills during mining and transportation can destroy life in large areas (water areas). And the question of the need for renewable energy sources is more relevant than ever.

"European countries have actively switched to renewable energy sources. In 2020, their share was 37% of the total electricity consumption," Eurostat reports. Among renewable sources, wind energy and hydropower account for more than two-thirds. In Scandinavian countries, such as Norway and Iceland, the share of renewable sources exceeds 100% – that is, they produce more green energy than they

consume.

Among renewable sources, wind energy and hydropower account for the most - more than two-thirds. It can be concluded that this is facilitated by the ideal terrain, for example, Norway with mountains, rivers and waterfalls, allows the construction of hydroelectric power plants without large dams, using natural lakes as reservoirs.

Hydroelectric power is produced by converting the potential energy of water into kinetic energy, which turns turbines, which then transmit mechanical energy to a generator, which converts it into electricity. Among the advantages of such production can be noted stability and renewable, and among the disadvantages, it is necessary to consider only the ecological impact and take into account the influence on the river regime and changes in the ecosystem.

Wind energy is another popular resource in European countries. Wind energy is obtained with the help of wind turbines (wind farms), which have giant blades that rotate under the influence of the wind. This rotation generates mechanical energy, which is then converted into electrical energy using generators. They are placed in open areas, coastal areas and offshore platforms where the winds are strong and stable. The plants have low operating costs and low emissions, but the operation of wind turbines depends on the presence of wind, which makes production unstable and requires large areas for construction.

Solar energy is growing most dynamically – if in 2008 it accounted for only 1% of energy consumption, now this indicator has increased to 14%. Solar energy is generated through the photovoltaic effect in solar panels, where light is converted into electrical current. However, in many parts of Europe, especially in the north, solar radiation is less intense compared to other regions of the world. This limits the efficiency of solar panels.

The next most popular is bioenergy. It uses organic materials, such as plants and waste, to produce energy. The two main types of biofuels are biodiesel, which is made from vegetable oils and animal fats, and ethanol, which is made from sugar or starchy plants. Biofuel is used in transport and for the production of electricity and heat at specialized power plants.

Geothermal energy is less popular in the world. It is obtained from the heat of the inner layers of the Earth through geothermal power plants. There are two types of stations: with steam and water turbines. Geothermal reservoirs are common in regions with hot springs, such as Iceland, New Zealand, and Kenya. Geothermal energy is also used for space heating and hot water in some regions, but it may not be economically viable for many countries. Drilling wells and installing geothermal plants requires significant financial investments.

To summarize, renewable energy is an important topic of discussion as it offers sustainable and environmentally friendly alternatives to traditional fossil fuels. In Ukraine, renewable energy sources have significant potential for development, especially in the context of the current challenges of energy security and environmental sustainability. Understanding the advantages and disadvantages of each type of alternative energy is key to choosing an optimal and efficient energy future.

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