Maltseva A.V., Matveeva T.V.
National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Kyiv, 37 Beresteyskyi ave.,
email: maltseva.angelina@lll.kpi.ua

THE COMBINATION OF ARTIFICIAL INTELLIGENCE AND 3D PRINTING

Анотація. *Поєднання штучного інтелекту та 3D-друку відкриває нові можливості в багатьох галузях. Це дозволяє автоматизувати процес 3D-друку, розвивати виробництва та покращувати якість продукції. Однак таке поєднання має свої труднощі. Хоча в Україні поки що не використовується така комбінація технологій, країна має певний потенціал у сферах медицини, прототипування та будівництва, що могло б прискорити розвиток та сприяти розв'язанню поточних проблем, зокрема в умовах війни.*

Abstract. *The combination of artificial intelligence and 3D printing opens up new opportunities in many industries. This allows you to automate the 3D printing process, develop production and improve product quality. However, this combination has its difficulties. Although Ukraine does not yet use such a combination of technologies, the country has the potential in the fields of medicine, prototyping and construction, which could accelerate development and contribute to solving current problems, in particular in conditions of war.*

Ключові слова: *3D-друк, штучний інтелект, інновації, поєднання технологій, війна в Україні*

Key words*: 3D printing, artificial intelligence, innovations, combination of technologies, war in Ukraine*

Artificial intelligence and 3D printing are two powerful technologies that create new opportunities for different industries. AI is a branch of science that creates intelligent systems capable of solving tasks that require a human mind, such as image recognition, decision-making, advising users, and creating original content. 3D printing is the process of making physical objects by sequentially applying layers of material to a digital model. Both of these branches have great potential for the development of science, education, medicine, industry, architecture, art and other spheres of human activity.

But have you ever wondered what opportunities open up when these two industries combine? What are the disadvantages and advantages of this combination? And most importantly, what role does it play for Ukraine in the current war?

The purpose of our study is to answer these questions by analyzing the current state and prospects for the development of a combination of AI and 3D printing. Consider the main directions and attached such synergy.

The combination of AI and 3D-druku creates new opportunities for innovation in various fields of activity. Using AI to design and optimize 3D models, and 3D printing for their physical implementation, it is possible to create complex and functional mechanisms that would be impossible to produce without these technologies. However, this combination has its strengths and weaknesses to consider.

Consider a variety of areas that use a combination of AI and 3D printing:

Design and construction: Artificial intelligence analyzes large amounts of data, optimizes design decisions, sets a budget, and generates various design options. 3D printing creates complex geometric shapes, reduces waste and increases efficiency. As a result, new materials, methods and models of construction are created, which are more adaptive and environmentally friendly than usual. However, the true potential of AI and 3D printing lies in their synergy. When creating complex architectural designs, artificial intelligence can create optimized 3D printing trajectories, reducing printing time and material consumption. In addition, AI monitors the structural integrity of 3D-printed components in real time, ensuring that they meet safety standards [1].

Using generative artificial intelligence, Apis Cor creates 3D printed houses that are affordable, sustainable and energy efficient. This made home ownership more affordable for everyone and also helped reduce the environmental impact of construction. This is a crap example of a combination of modern technology [2].

Education: 3D printing and AI encourage students to actively participate in learning, giving them the opportunity to create their own projects, experiment and receive feedback. They also develop creativity, logical thinking, analytical skills. There is an improvement in the quality and accessibility of education. 3D printing and AI help teachers prepare effective and individualized learning materials tailored to the needs and level of students. They can also provide distance learning using online platforms, virtual assistants or interactive simulations.

However, 3D printing and AI also have some disadvantages for education, such as: expensive hardware and software, violation of ethical and social issues related to copyright, privacy and security, the need for training and support of teachers, changing approaches to teaching, focusing more on facilitation or mentoring.

An example of such a combination of technologies is the FabMaker Studio project in the USA, which allows students to design and create 3D models from paper, cardboard, fabric and other materials using 3D printers, cutters and robots. Artificial intelligence is used to analyze data about the learning process, adapt tasks to the level of students, provide feedback and advice [6].

Medicine: Powerful technologies such as 3D printing and artificial intelligence have a significant impact on the medical industry. However, they require a careful and critical approach to their development and application to ensure their safety and effectiveness. The field of medicine does not fully utilize these technologies due to the fact that AI is often inaccurate and unverified, and 3D printing has limitations on the quality and availability of materials and equipment. Therefore, it is necessary to continue researching and improving these technologies, as well as to develop appropriate rules and regulations for their regulation and control [3].

The manufacture of a complete mitral valve apparatus is an example of how artificial intelligence and 3D printing can be applied in medicine. The models were segmented with 3D ultrasound, and then the 3D printing molds were calculated automatically and printed on a solid material, the lower part of which was water soluble. The production time was approximately 36 hours per valve. Twelve surgeons performed various surgical techniques, such as anuloplasty, neochord implantation, and triangular leaflet resection, and very positively evaluated the realism of the valves [4].

Fashion: The fourth industrial revolution influenced society's development, which led to a revolution in business management methods. Artificial intelligence has become part of doing business in various industries, and the fashion industry is no exception. Fashion has always looked to the future and captured new technologies when they appeared. Artificial intelligence works and moves at the speed at which fashion moves.

Examples of how artificial intelligence and 3D printing can work together in the fashion industry are the creation of hybrid materials that combine the properties of different fabrics and synthetic substances, which improve comfort,

functionality, and style of clothing. The Ministry of Supply employs artificial intelligence to analyze temperature and sweat data, and then utilizes 3D printing to produce clothing that can adjust to the wearer's climate and activity [5].

In different parts of the world and in different fields of activity, the integration of AI and 3D printing is used to create a prosperous future. What is the significance of this combination for Ukraine in the context of the current war?

The combination of AI and 3D printing can play an important role for Ukraine. With them, you can create a variety of military equipment, such as drones, periscopes, protective shields, harnesses and prostheses. This will help reduce dependence on foreign suppliers. We already know that AI and 3D printing can produce individual medical implants, prostheses, orthoses, stents that take into account the characteristics of each patient. It can improve the quality of life of people affected by war, as well as reduce the risk of complications and rejection. We also learned that with AI and 3D printing, you can create interactive and visual materials for learning and research. The education of the younger generation should be given special attention, as they should be responsible for reviving the country after the war and raising its economic status on the world stage.

So, although AI and 3D printing technology is not yet perfect, we already see that this industry has great potential in various spheres of human activity, especially for Ukraine. Therefore, it is worth financing the development and implementation of AI and 3D printing in Ukraine, because it can give an advantage over the aggressor, improve the welfare of the population, strengthen the country's position in the international arena.

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