Impact of Artificial Intelligence on the Development of Art Projects: Opportunities and Limitations

Zheng Xiang[1], Xiong Jinghao[1], Cao Xiaoming[1] and Y. V. Nazarov[1]

[1]A. N. Kosygin Russian State University (Technology. Design. Art), Moscow, Russia

Summary
To date, the use of artificial intelligence has already brought certain results in such areas of art as poetry, painting, and music. The development of AI and its application in the creative process opens up new perspectives, expanding the capabilities of authors and attracting a new audience. The purpose of the article is to analyze the essential, artistic, and technological limitations of AI art. The article discusses the methods of attracting AI to artistic practices, carried out a comparative analysis of the methods of using AI in visual art and in the process of writing music, identified typical features in the creative interaction of the author of a work of art with AI. The basic principles of working with AI have been determined based on the analysis of ways of using AI in visual art and music. The importance of neurobiology mechanisms in the course of working with AI has been determined. The authors conclude that art remains an area in which AI still cannot replace humans, but AI contributes to the further formation of methods for modifying and rethinking the data obtained into innovative art projects.

Keywords:
AI, visual art, music, imitation, generative art.

1. Introduction

Digital technologies have become an integral part of people's lives over the past decades [1,2]. The process of their active development and implementation is inevitable and at the same time may be imperceptible at first glance [3,4]. However, it determines the key vectors of further development of many spheres of social life [5,6]. The achievements of artificial intelligence (AI) are being actively implemented in the information sphere, in medicine, to automate routine processes in various industries [7]. Technologies are becoming an experimental field for the discovery of new means and methods of creation in the artistic sphere [8], and their rapid development and active involvement in cultural practices [9] confirm the need for scientific research.

The process of creating new social and cultural forms is significantly modified in the postmodern era and offers a much greater number and variety of forms [10]. Previously unknown forms of human cultural expression are being created in the new digital, information space, in particular, virtual reality, cyberspace, digital culture, and the like [11]. According to researchers [12,13], regardless of how AI will develop in the future, it will not be able to replace people in the field of creativity, it will never be able to create, and not reproduce or combine. Meanwhile, the process of human creative activity becomes significantly connected with the activity of AI, which can cause a kind of revolution in the field of art and push artists to constantly update and develop artistic styles, producing unexpected combinations of figurative elements as a result of work, which ultimately leads to the actualization of the question of essential, artistic and the technological limitations of AI art.

2. Literature Review

The first AI research began in the 1940s-1950s. They were associated with attempts to teach a computer to apply formal logic like a human, but these attempts did not have the expected results. The main question that was asked by Alan Turing, one of the first AI researchers and theorists: is a machine capable of thinking like intelligent creatures [14]. To do this, he proposed to conduct an experiment known as the Turing test. He offers a game with three participants — two people and one computer. The task for one of the human participants is to understand which of the interlocutors is a person, and which is a computer imitating human behavior. The Turing test was severely criticized, because, according to scholars [15], it demonstrated the ability of a computer to be like a human, but did not reveal its ability to think.

The next wave of developments in the field of AI is associated with the deep learning method, which has been developing most intensively over the past ten years and is based on huge arrays of electronic data sorted by hierarchies, some of which simulate the flow of information, which resembles the functioning of neurons in the brain [16].

It's worth noting that the first definition of AI was introduced into scientific circulation by J. McCraty from Stanford University in the second half of the 20th century [17]. Today, AI as a whole is understood by experts as modeling the processes of human intelligence with the help of machines, computer systems, which includes learning (obtaining information and rules for its use), reasoning (using rules to reach approximate or certain conclusions) and self-correction [18]. P. M. Morkhat [19] reveals AI as a fully or partially autonomous self-organizing (self-

Manuscript received September 5, 2022
Manuscript revised September 20, 2022
https://doi.org/10.22937/IJCSNS.2022.22.9.45

organized) computer-hardware-software virtual or cyber-physical, including bio-cybernetic, system, endowed/possessing the ability to think, self-organize, learn, independently accept solutions, etc.

J. Zylinska [20] compares the decision-making mechanisms in the creative process of a person and a computer that processes data based on an algorithm. The researcher came to the obvious conclusion about the imperfect approximation of the computer to the person at this stage. We trace a similar thought in [21], where it is argued that modern AI can model only the features of perception and the process of thinking, but not emotions and motives.

Researchers [22], putting forward proposals for the definition of AI in art, advise applying the Turing test in art, suggesting that art historians recognize a work generated by AI as art. Other researchers [23] interpret the creative process in AI systems as a purposeful, time-consuming transformation, which implies a reflection of any sphere of reality and the construction of a new product.

A significant part of works devoted to the use of AI in the field of art belongs to practicing artists who share their experience analyzing the process of working with technologies [24-26].

Researchers [27,28] consider AI-driven art in the context of socio-political and environmental problems of our time, actualizing the question of the ontological and technological specifics of AI art, its purpose, and potential audience. The paper [29] analyzes the participation of AI in the formation of the modern aesthetic experience of the theater audience. In addition, annual workshops on machine learning technologies in artistic practices have been held within the framework of the NeurIPS conference since 2017, where algorithms for generating and creating new media are discussed [30].

However, there are no studies in which AI would be considered a tool of culture and a means of creating fundamental innovations in contemporary art. Therewith, understanding the problems of AI as a creator of works of art will make it possible to comprehend its creative potential, which is relevant since AI is currently becoming a product and tool of socio-cultural development.

The purpose of the article is to analyze the essential, artistic, and technological limitations of AI art.

Research objectives:

- to identify methods of involving AI in the creative process;
- to carry out a comparative analysis of the methods of using AI in visual art and in the process of composing music;
- to identify typical features in the creative interaction of the author with AI.

Research hypothesis: art remains an area in which AI still cannot replace humans, but AI contributes to the further formation of methods for modifying and rethinking the data obtained into innovative art projects.

3. Methods

The data for this study was taken from a review of secondary sources. The source base of the study was represented by two arrays of literature. The first array consists of studies aimed at studying existing AI, as well as problems arising from their use. The second array consists of studies aimed at analyzing the prospects of using AI in the field of art, their capabilities, as well as their impact on the future of art.

When forming the source base of the research, keywords were used when searching on the Internet – "artificial intelligence", "art", "music", "visual arts".

The analysis of the research source base using the methods of theoretical generalization, comparative analysis, analysis, and synthesis made it possible to identify ways to attract AI to the creative process, to carry out a comparative analysis of the methods of using AI in visual art and the process of composing music, as well as to identify typical features in the creative interaction of the author with AI.

4. Results and Discussion

Methods of involving AI in the creative process were identified based on the analysis of the literature, their characteristics and examples of implementation were given (Table 1).

Table 1. Methods of involving AI in the creative process

	Methods of involving AI in the creative process	
	Imitation	**Generative Art**
Characteristics	One of the early methods of attracting AI to art. As a rule, imitation of historical art, namely the characteristic stylistic features of a certain author or style direction	Based on the analysis of a large amount of information. A new image or musical composition is created using the technology of generating (GAN) or creative (CAN) adversarial networks
Realization	The Next Rembrandt project, Choral program	Visual projects Hyperbolic Composition I-II, "Neural Zoo" Music generation programs AIVA, Emili Howell, Iamus. Endel application for creating soundscapes

Let us consider examples of the use of AI in visual art and music, summarizing the research conducted in this area.

First of all, we consider it necessary to highlight the "Imitation" technique. A well-known example of style imitation is The Next Rembrandt project, which was created as a result of a deep learning algorithm that analyzes more

than 300 scans of existing Rembrandt works and their most characteristic features [16]. Based on the analysis, AI created a new image with features characteristic of Rembrandt's style, which was printed on canvas with similar oil paints. Later, the State Museum of the Netherlands restored fragments of the "Night Watch" painting cut in the past in a similar way.

The Choral program was created on a similar principle in the music field. It was developed in the 1980s by K. Ebcioglu to harmonize chorales in the style of J.S. Bach. A program based on a choral melody, which he perceives through its alphanumeric encoding and based on the principles of harmony and melody characteristic of the music of the German composer, can produce a harmonized musical notation of the finished chorale. According to the author of the program, the competence of the program is "close to the competence of a talented student-musician who studied Bach chorales" [26, p. 43]. K. Ebcioglu [26] notes that the method of generating and testing on which the program is built is not necessarily an accurate cognitive model of the human compositional process, it seems to work, and it seems that it is capable of producing musical results. L. Manovich considers such use of AI to be unpromising, because, in his opinion, AI is not able to fulfill the main strategy of modern art imitating historical art – to constantly expand what is considered art [21].

We believe that the second technique is "Generative Art". A new image or music is created using the technology of generating adversarial networks (GAN), based on the use of two neural networks, one of which generates pseudo-random images from a given set of available information, and the second determines whether the image was created by a person based on a training set. The option is considered unsuccessful in case of a negative answer. Thus, the network learns to choose the right option from a set of fake and man-made images. The technology of creative adversarial networks (CAN) for creating digital paintings is based on the generation of random images, which adds spontaneity to AI creativity and allows taking a step forward compared to GAN technology [16].

According to the researchers, these results are spectacular, but often, apart from curiosity and admiration for novelty, they do not cause other feelings, because they are not rich in content or conceptually. J. Zylinska [20] believes that such a generation of visual and algorithmic variations in a closed system only irritates the public with the "promise of novelty".

An example of generative AI creativity in visual art is the work of Scott Eaton. The artist, in search of new means of expression, combines traditional methods of work with modern digital tools — photography, sculpture, drawing, and the method of deep learning of AI, which can generate textures based on photos uploaded to its database. In his works Hyperbolic Composition I-II, the human body acquires abstract forms and angles [25].

Several programs have appeared in recent years that generate music based on the analyzed works, for example, the AIVA program. Created in 2016, the program has already been recognized by the Society of Authors, Composers, and Publishers of Music (SACEM) as an electronic composer. The user can generate instrumental music of different genres through the program's website. Such music may well be used in films, games, commercials, TV shows, and the like. The developers of the system analyzed more than 30,000 musical scores and converted them into a matrix form. AIVA searches for patterns in its thesaurus, generates a set of mathematical rules specific to a particular style of music, and thus creates an integral piece of music using multi-layered neural networks. The user can create a track by choosing the style, instrumental composition, tempo, meter, and duration on the website. It is possible to change the audio track in the editing mode, change or completely regenerate a certain part of the work, as well as add effects (bass amplification, vinyl sound effect, reverberation, etc.).

The next program – Emili Howell – has two components in its composition. The first of them was created by David Cope back in the 1980s to identify his stylistic solutions in his works, and later the developer added works by other composers to the analytical base of the program. Cope developed the second part of the Emily Howell program for creating music in 2003. Like AIVA, the Emili Hauel program generates musical compositions based on pre-downloaded and analyzed works. However, its important difference from other programs is the inherent ability to react and take into account decisions in the process of creating a composition [28].

Thirdly, we highlight – we see the application of neurobiology mechanisms in the process of creation in the works of Sofia Crespo. The artist explores how organic life uses artificial mechanisms for modeling and development, her work calls into question the potential of AI in artistic practice and its ability to change our understanding of creativity [27]. On the other hand, the artist is concerned about the dynamic change in the role of artists working with machine learning techniques [16]. In the Neural Zoo project, Crespo uses AI to recombine natural textures of plants or animals to generate images that, due to the naturalness and familiarity of the elements, at first seem familiar to the viewer. However, they strike with the harmony of the combination of the allegedly incongruous during a more detailed examination.

Another example of involving AI in the process of creating personalized musical accompaniment is Endel. The application, created in 2018, allows the user to customize soundscapes. Depending on the emotional state, it can be adjusted, for example, to reduce stress, improve sleep quality or increase productivity at work. The sound result may depend on a person's mood, heart rate, weather, time of day, and other parameters. Due to the possibility of

integrating the Endel Pacific interface with various devices, indicators are read from them and, according to the laws of neurobiology, the sound landscape changes in real-time, responding to input data. Endel Pacific developers see the prospect of integrating their product into the work and training process, as well as in the automotive sector to support the concentrated state of drivers, stating an increase in concentration up to seven times due to listening to a personalized soundscape. The purpose of this development, according to the manifesto of its authors, is to help our body and brain adapt to the new world [24].

The principle of operation embedded in the algorithms of the Iamus program, which creates music of an academic direction, seems promising. The work of the system is built like the principle of evolution when each composition has a musical core, which becomes more and more complex and automatically develops [22]. The program can create a large number of compositions and displays them as a score. The difference from the previous examples is that Iamus is not able to perform the music that it created, but it is the only one focused on the process of developing musical material, unlike others that are aimed at finding typical sonorous solutions and at the same time are based on the analysis of uploaded to its library.

We can state the similarity of the basic principles of their work having considered the programs that generate an image or music based on AI. Thus, at the first stage, certain information is loaded into the program – photographs, paintings by famous artists, or musical scores following the choice of developers and depending on their purpose. Next, the AI analyzes the information, finding patterns or characteristic features within the available content, and outputs the result following the algorithm.

One of the key features inherent in AI and physically inaccessible to humans is the ability to analyze large amounts of information and then search for certain patterns in it. L. Manovich, defining the art of AI as an art that people cannot create due to the limitations of their body, brain, and other limitations [14], cites MuseNet as an example of AI art – a deep neural network capable of combining different styles of music within one piece. However, there have already been experiments with a combination of different styles in the history of the music of the twentieth century. In our opinion, the music created by this program does not expand the boundaries of art and is not something that a person is not able to do. Therefore, today art is still considered an area in which AI still cannot replace a person, since the process of creating works of art is the result of people's mental activity, the result of repeated reflections, constant generalization, and personal perception.

5. Conclusions

We can identify several methods of work having considered examples of the use of AI in visual art and music. The first of them is the imitation of historical art. Generative art was the result of the next, more complex method of working with AI, based on deep learning technology.

Special attention should be paid to the significant role of the mechanisms and laws of neurobiology in the use of AI in the field of art: transfer of mechanisms of organic life to generate images from combinations of natural textures; artificial neural network allows finding formulas characteristic of a certain style of music in the thesaurus and generating a set of mathematical rules for further generation of a complete piece of music; the laws of neurobiology are applied to read information about various indicators of the human condition to modify the soundscape in real-time for certain purposes, for example, reducing stress or, conversely, increasing efficiency and concentration.

Now the process of artists exploring the possibilities of AI is in an active stage. Experimental searches for new means and methods of work are carried out in various artistic directions. Realizing the dynamism of technology development and further corresponding changes in people's minds, we consider indisputable the great potential for further development and implementation of AI in various fields of activity in the future, in particular in the field of culture and art. AI opens up the ability to analyze and process information that was previously unavailable.

Thus, the results of the study confirmed the hypothesis that art remains an area in which AI still cannot replace humans, but AI contributes to the further formation of methods for modifying and reinterpreting the data obtained into innovative art projects. This makes it possible to state the renewal of the usual ideas about the creative process and the mechanisms of perception of works of art.

Therewith, the phenomenon of AI in art requires further research, including its ability to think creatively, the possibility of creating works of art without human participation.

References

[1] Aleksandrova, I. B., Vorobyova, K. I., Gileva, N. V., Livson, M., Cheprasova, T. V., Bazhin, G. M.: *Influence of ddigital assistive technologies used in higher education on the development of individual educational strategies among students with disabilities*. International Journal of Early Childhood Special Education 13(2), 1146–1153 (2021).

[2] Nimatulaev, M. M., Sirbiladze, K. K., Tsvetkova, O. N., Ivanova, L. I., Shelygov, A. V.: *Digital technologies as a factor in increasing services sales in tourism industry*. Journal of Environmental Management and Tourism 12(4), 916-921 (2021).

[3] Kirillova, E. A., Zulfugarzade, T. E., Blinkov, O. E., Serova, O. A., Mikhaylova, I. A.: *Prospects for developing the legal*

regulation of digital platforms. JURÍDICAS CUC 18(1), 35–52 (2021).
[4] Mkrttchian, V., Kharicheva, D., Aleshina, E., Panasenko, S., Vertakova, Yu., Gamidullaeva, L.A., Ivanov, M., Chernyshenko, V.: *Avatar-based learning and teaching as a concept of new perspectives in online education in Post-Soviet Union countries: theory, environment, approaches, tools*. International Journal of Virtual and Personal Learning Environments 10(2), 66–82 (2020).
[5] Bezpalov, V. V., Solopova, N. A., Shilina, M. G., Avtonomova, S. A., Gorina, T. V.: *Formation of an intelligent control system in the field of electric power industry based on the technological development of power supply components*. Periodicals of Engineering and Natural Sciences 9(3), 218–235 (2021).
[6] Korneev, D. G., Gasparian, M. S., Gavrilov, A. V., Sysoev, N. A., Filyuk, M. A.: *Creating a service-oriented information and educational space*. International Journal of Emerging Technology and Advanced Engineering 12(2), 153–158 (2022).
[7] Esin, I. V., Balakin, K. V.: *Medical diagnostic decision support systems based on artificial intelligence algorithms*. International Journal of Emerging Technology and Advanced Engineering 11(12), 28–38 (2021).
[8] McCormack, J., Gifford, T., Hutchings, P.: *Autonomy, authenticity, authorship, and intention in computer generated art*. In: Ekárt, A., Liapis, A., Castro Pena, M. L. (eds.) Computational intelligence in music, sound, art and design. EvoMUSART 2019. Lecture notes in computer science, vol. 11453, pp. 35–50. Springer, Cham (2019). https://doi.org/10.1007/978-3-030-16667-0_3
[9] Lomas, A.: *On hybrid creativity*. Arts 7, 38–48 (2018).
[10] Savenkova, L., Fomina, N.: *Object-spatial approach to studying fine art: development of three-dimensional and spatial perception among students*. Rupkatha Journal on Interdisciplinary Studies in Humanities 9(2), 282–292 (2017).
[11] Arcas, B.A.Y.: *Art in the age of machine intelligence+*. Arts 6(4), 34-43 (2017).
[12] Du Sautoy, M.: *Can AI ever be truly creative?* The New Scientist 242(3229), 38–41 (2019).
[13] Hertzmann, A.: *Computers do not make art, people do*. Communications of the ACM 63(5), 45–48 (2020).
[14] Chen, W., Shidujaman, M., Tang, X.: *AiArt: towards artificial intelligence art*. In: MMEDIA 2020: The Twelfth International Conference on Advances in Multimedia, pp. 47–52. IARIA (2020).
[15] McCarthy, D., Minsky, M. L., Rochester, N., Shannon, C. E.: *A proposal for the Dartmouth Summer Research Project on artificial intelligence*. AI Magazine 27(4), 12–14 (2006).
[16] Pearlman, E.: *AI comes of age*. A Journal of Performance and Art 42(3(126)), 55–62 (2020).
[17] Li, Y.: *20 years of digital art*. IT Manager World 495, 68–71 (2018).
[18] Torre, G.: *Expectations versus reality of artificial intelligence using art to examine ontological issues*. Leonardo 50(1), 31–35 (2017).
[19] Morkhat, P. M.: *Iskusstvennyi intellekt: pravovoi vzglyad: monografiya* [Artificial intelligence: legal view: a monograph]. Buki Vedi, Moscow, 258 pp. (2017).
[20] Zylinska, J.: *AI art machine visions and warped dreams*. Open Humanities Press, London, 176 pp. (2020).
[21] Galanter, P.: *Towards ethical relationships with machines that make art*. Artnodes 26, 14–22 (2020).
[22] Caldas Vianna, B.: *Generative art: between the nodes of neuron networks*. Artnodes 26, 80–87 (2020).
[23] Cho, O. H., Lee, W. H.: *Application of reinforcement learning system to interactive digital art*. Journal of Internet Technology 14, 99–106 (2013).
[24] Czarnecki, G.: *Artworks*. Gina Czarnecki's Website (2018). https://www.ginaczarnecki.com/artworks
[25] Eaton, S.: *Entangled II*. Scott Eaton's Website (2020). http://www.scott-eaton.com/2020/entangled-ii
[26] Ebcioğlu, K.: *An expert system for harmonizing four-part chorales*. Computer Music Journal 12(3), 43–51 (1988).
[27] Galanter, P.: *Generative art theory*. In: Paul, C. (ed.) A companion to digital art, pp. 146–180. John Wiley & Sons, Inc., Chichester (2016).
[28] Reckwitz, A.: *The invention of creativity: Modern society and the culture of the new*. Polity Press, Cambridge, pp. 324–333 (2017).
[29] Smith, G. W., Leymarie, F. F.: *The machine as artist: an introduction*. Arts 6(2), 5 (2017).
[30] Elgammal, A., Liu, B., Elhoseiny, M., Mazzone, M.: *CAN: creative adversarial networks generating 'Art' by learning about styles and deviating from style norms*. In: Eighth International Conference on Computational Creativity (ICCC) (2017). https://arxiv.org/abs/1706.07068