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## “TECHNOLOGICAL” ART AS A PROBLEM OF TECHNOLOGY AND ART INTEGRATION

**The purpose of the article** is to study technology influence on various types of art, in particular, painting, music, architecture, video art, screen, and spatial arts. **The research methodology** is based on the application of analytical, theoretical, and conceptual methods of technological art research and the relationship between digital technologies and art in general. **The scientific novelty** lies in the fact that for the first time the art forms created with digital technologies have been analyzed. The technological art phenomenon as a result of the art and technology integration has been considered. **Conclusions.** Now the process of mutual influence of modern creative technologies and art is reciprocal. On the one hand, the technology influence on art creates new technological art forms (electronic music, computer graphics, digital painting, etc.), based on a computer method and have an artistic direction, on the other hand, the study of the compositional construction of musical works and paintings as a mathematical pattern the certain sound (color) repetition give grounds for understanding the art influence on the development of modern digital technologies.

*Key words:* technology, “technological” art, algorithm, technique, digital painting, electronic music, architecture, video art.

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### **Технологічне мистецтво як проблема інтеграції технологій та мистецтва**

**Метою статті** є дослідження впливу технологій на різні види мистецтва, зокрема, живопис, музику, архітектуру, відео-арт, екранні та просторові мистецтва. **Методологія дослідження** ґрунтується на застосуванні аналітичного, теоретичного та концептуального методів дослідження технологічного мистецтва та взаємовідносин між цифровими технологіями та мистецтвом загалом. **Наукова новизна** полягає в тому, що вперше проаналізовані мистецькі форми, які створені за допомогою цифрових технологій. Розглянуто феномен технологічного мистецтва як результату інтеграції мистецтва та технологій. **Висновки.** Нині процес взаємовпливу сучасних креативних технологій та мистецтва є взаємооберненим. З однієї сторони вплив технологій на мистецтво породжує новітні технологічні види мистецтва (електронна музика, комп'ютерна графіка, цифровий живопис тощо), засновані комп'ютерним способом та мають художню спрямованість, з іншої сторони вивчення композиційної побудови музичних творів та творів живопису як математичної закономірності повторення тих чи інших звуків (кольорів) дають підстави для розуміння впливу сааме мистецтва на розвиток сучасних цифрових технологій.

**Ключові слова:** технологія, «технологічне» мистецтво, алгоритм, техніка, цифровий живопис, електронна музика, архітектура, відео-арт.

Relevance of the research topic. The computer and digital technology development rapidly entered the art world and had a great influence on its development in the 20th century. For culture and art researchers, this topic is of considerable interest, since it allows us to trace historically and analyze the most important trends in cultural dynamics theoretically, so that specifies the historical development of art and culture in the 20th century.

Recent research and publication analysis. In recent years, significant historical, cultural, and theoretical works have been published where much attention has been paid to the cybernetic art history as the forerunner of the late twentieth century digital culture. Among them are publications by V. Glushkov (1986) [3], M. Lovejoy (2004) [11], F. Popper (2007) [12], D. Galkin (2013) [2].

G. Franke [10], D. Galkin [2] and M. Lovejoy [12] examine the concept of “digital culture” and explore the features of technology and art hybridization.

R. Zaripov [4-5], Ts. Kogoutek [6], V. Shcheglov [8-9], D. Shavligin and A. Obmorokova [7] have studied digital technology and art interrelation. In the article “Painting of the 20th Century: Fundamentals of Algorithmic Interpretation” [8], “Poetry: Fundamentals of Algorithmic Interpretation” [9] by means of the poetry and painting example. V. Shcheglov points out to a series of repeating sequences in the context of artistic content, which the author calls algorithms, and therefore, poetry and painting are algorithmic systems. R. Zaripov discovers similar algorithmic feature through musical work construction in his articles “Cybernetics and Music” [4], “On the Algorithmic Description of the Process of Composing Music” [5].

However, despite the public interest in technological art, there is a lack of scientific justification for the possible technology and art interaction in general and a critical analysis of the technological art functioning specificity.

The purpose of the study is to analyze the forms of modern technologies and various art type interaction, to identify such art forms that can be organized (created) exclusively through digital (or other) technologies.

The presentation of the main material. The artistic activity originated in primitive society during the late Palaeolithic and left its mark in cave paintings, carvings on stone and bones. Our ancestors made the first tools, household items, and housing with instruments. So, using those instruments in a certain way was a technology for creating an artifact.

As you know, “technique” (technical equipment) is not an unfamiliar concept for art. If technology, that is “the logic of technique”, is meaningful in its laws, it becomes the basis of the creative method, if it is aestheticized, it becomes a figurative and expressive means of art [1, 29].

With the advent of new technologies and innovative developments in the world, art is certainly trying to attract them into its space. Through the evolution of writing from subject writing (where people transmitted information with various objects) to pictographic and hieroglyphic writing, from syllabic to alphabetical, from manuscript to print, it is clear that the technology advent changes the course for the development of a particular human activity type.

According to D. Galkin, the 15th-century press introduction marked the beginning of technologically artistic hybridization [2, 45].

Here we will make some clarifications: considering that artistic activity, like any other production activity, involves certain technical equipment use, and therefore technology, so, it becomes technological from the first days of its existence.

Therefore, we are dealing with the concept of “technological art”.

The term “technological art” was proposed by French historian and art critic Frank Popper [10], who defined technological art as the result of the fundamental art and technology integration, rather than a simple aestheticization of the latter.

Now the process of mutual influence of modern creative technologies and art (the artistic component) is reciprocal.

The technology of fixing the print, and alter the appearance of the first photograph (beginning of the 19th century) and sound recordings (70 years of the 19th century) become indispensable facts that technologies actively spread in the artistic space. With the advent of screen arts (cinema and television), it becomes clear that the further art development depends mainly on the technical component; the role of technology in the art form development is significantly enhanced (by the way: we can name audio-visual the thing that should be recorded on a material medium and reproduced with equipment).

The rapid development of audio-visual fixing material methods and computer technology contributes to the emergence of European art forefront of the twentieth century, as well as the art direction of “video art”, which is also characterized by the video equipment use. The technical component of the video art product manufacture is the use of television sets, video cameras and

monitors, projectors, screens, and other equipment that is used in media product manufacture.

Both computer technologies and audio-visual ones are actively integrating into the art space. Given that the computer technology peculiarity is often the need for feedback in the living and non-living world, technological art of the twentieth century becomes interactive and reversed under the cybernetics influence. There are numerous video and television projection installations with the ability to convert images in real-time. The video art founder, the American artist Nam June Paik installs a television receiver into the sculpture and invites viewers to change the image on the monitor personally with a magnet in his installation.

Another technological invention in video art space is Gordon Pask's interactive machines and sculptures: "Musicolour" (1950) is a device that coordinates the light pattern according to the musical fragment sound character (if music is funny, this device reproduces a dynamic light pattern, if it is calm, the movement of colored lights becomes slow). Pask created installations with interactive works that adapted to each other and participated in the development of the interactive theatre concept, where spectators and actors could jointly decide how the action will develop in a particular episode.

It is worth reminding that the computer calculation technologies had nothing to do with the world of art from the beginning of their inception. These were purely commercial mathematical developments in the field of cybernetics. The computer, having entered everyday human life, began to be used in all areas of his life. The artistic activity was no exception. Machinery and computerization technologies have interested musical, theatre, visual art figures, composers, stage directors, producers, and so on.

In everyday life, the concept of the "creative process automation" not familiar to the perception and understanding began to be used. There is a tendency to draw on computer technology anywhere, even there where such use would seem impossible.

At the beginning of the XX century with the development of machinery and cybernetics experiments with the introduction of computer and computing technologies in the visual arts and sculpture began. So, the phenomenon of "kinetic art" appears.

Kinetic objects are moving devices, which create unusual visual, and sometimes sound installations with light and the constituent element movement. These meticulously designed devices made of metal, glass, or other materials, connected to flashing light devices, are called "mobiles". Now there are a lot of art kinetics artifacts: kinetic miracle

animals of the Dutch artist and sculptor Theo Jansen (mechanisms which resemble giant skeletons that are moved with the wind), the works of the American sculptor Anthony Howe are from rough material such as steel reinforcement and alloy wheels. Their peculiarity is that they are in constant movement and are constructed according to appropriate mathematical calculations with cybernetic technologies.

An example of a kinetic installation shows that due to certain manipulations with light, movement, and space, the illusion that "time penetrates a work of art" with the help of certain "technology" arises.

Theatre and stage as the art of communication between an actor (an artist on stage) and the audience also change as a result of the introduction of machinery and related technological experiments with light and space. V. Meyerhold in Russia, F. Marinetti in Italy, O. Schlemmer in Germany were the pioneers of the theatre mechanization and the creators of a new aesthetic platform to substantiate their experiments.

The modern process of writing a piece of music that a computer system can handle is astonishing. Modern technologies for calculating musical composition, tonal coloring, and harmony can offer a person many variations of one melody created according to all the canons of musical notation and solfeggio.

Currently, many mathematical experiments are being conducted with these mathematical machines. L. Theremin invented the Theremin tool, which allows you to remove sound without playing your hands on it. Research experiments with the musical form of Leyaren A. Hiller, professor at the University of Illinois, and his collaborators, including Leonardo Isaacson, with the "Illiac computer", Janis Xenakis and Max Matthews which are electronic music creation synthesizer, creating variations of musical scores, acoustic analysis of work are known.

Electronic music demonstrates a variety of new timbre and orchestral sounds that are extremely difficult to obtain in a natural way (without using a computer). Now such music is quite popular, it is used even for commercial purposes. Hiller's world-famous electronic "Illiac Suites", where musical counterpoint is equated to a mathematical algorithm; thus, a musical composition is created by machine. Similar attempts were made with dodecaphony and serialism, where it is also possible to observe the repetition of certain musical fragments-algorithms. The theory of algorithms is the basis of cybernetics and first of all, has been developed by Soviet scientists Andrew Markov and Peter Novikov.

The Soviet scientist R. Zaripov spent his whole life studying algorithmic music modeling and created some musical experiments on the Ural electronic computer.

Another example is the soundtrack to the series "Solaris" (dir. A. Tarkovskiy, 1972). In the process of creating music for the film, the composer introduced a certain melody into the computer system, which served as the leitmotif of the entire musical form – the audio editor, in turn, arranged it, changing the timbre, color, and sound of the instrument, while giving fundamentally new variations of the melody. Thus, the composer is a bandsman who creates a kind of orchestra without he performer participation, which significantly reduces and optimizes the time and effort of writing music. And the most important thing is that there are opportunities for writing music, which is simply impossible to create in any other way.

Functionally, the process of writing music electronically is as follows. The creation of compositional structure by a computer is preceded by all musical element conversion into numbers ("computer language"). According to the program set by the composer, the selected musical style is based on the compositional principles, each number is instantly checked by the machine using simple arithmetic tests (yes-no), as far as it is suitable for this program. In the case of the positive answer, it is accepted, in the case of the negative one, it is rejected. The result is transmitted to a special machine for printing notes. Thus, the composer receives a printed sheet with notes for future use.

The fact of creating complex electronic compositions in the style of famous composers with electronic computers is particularly impressive. In this context, the system reveals the features of the composers' musical style, for example, J. Sebastian Bach, and then, introducing an element of randomness, which does not affect the style peculiarities, makes up some kind of organ music, fugue or toccata. However, even the connoisseur of the composer style does not have any doubts about composer authenticity.

Modern technologies make it possible to "restore" fragments of musical compositions lost by history and even archive them. Even at the congress of the International Federation for Information Technology (1968), one of the reports revealed the problem of electronic computer use in musicology. Now, through the joint efforts of mathematicians and musicologists, computer music archives are being created. So, for example, there is an archive of Spanish music of the XVI century [3].

As for literature and poetry, of course, considering the verse size, the writing style, it is possible to obtain a literary product using

technology. But this product is artistically filled. Such systems cannot compete with real writers. The difficulties that must be overcome when compiling the appropriate programs do not justify themselves. Today it is obvious to everyone that a person's intuition and worldview, his life experience are elements inaccessible to a computer system.

However, the facts of using the cybernetic machine of Albert Ducrock "Kalliope" which makes up surrealistic verses are known. Along with algorithmic electronic music, the algorithmic painting appears. It is known that painting and architecture masters have always been interested in mathematical calculations, issues of proportion and symmetry, perspectives, and large-scale relationships for reproducing a realistic or, on the contrary, too perfect image in their canvases. The artistic direction of "cubism" was based on mathematical calculations of four-dimensional space – in particular, studies by E. Zhuffre, 1903, Leonardo da Vinci's polyhedra, fractal graphics, "Black Square" by Kazimir Malevich, and "Arithmetic Composition" by Theo van Doesburg (1929-1930). These are just some of the artifacts that show the mathematics influence on painting.

It is worth considering digital painting as one of the modern types of technological art.

An American mathematician and artist, Ben Laposki is the founder of the digital painting genre. He managed to create graphic images using an analog computer (1952); with the help of the cathode tube of an oscilloscope, he created compositions called "Electronic abstractions" (or "Oscillons"). German scientist Herbert Franke, experimenting with oscillograms, "drawing" abstract compositions, developed computer graphics, and wrote the first book in the history of digital art on computer graphics ("Computer Graphics – Computer Art") [10].

Desmond Paul Henry created The Drawing Machine (1962), which could create complex, abstract, asymmetric, curved, but repeating drawings. An American artist Charles Csuri (1964) painted a series of digital images based on paintings by famous artists.

The American artist Michael Knoll was the first in the history of computer art who was interested in the exclusively aesthetic value of digital images created. He created his very first work in 1962. In one of his early experiments, Noll tried to compare a picture of a famous artist with a computer-generated drawing. Noll's digital art exhibition in New York in 1965 was the first such exhibition in the United States. Later, in the late 1960s and early 1970s, Knoll designed an interactive 3D input device, as well as a number of other devices that became the forerunners of modern

virtual reality systems. Knoll's work, "Computer-Created Ballet," was the first animated work done on a computer. "Ballet" was a dance of stylized figures on the stage. A lot of Noll's works have been exhibited around the world, and some of them have rightfully taken their place in the collections of major museums.

Contemporary artists, including Michael H. Christensen, work in the genre of algorithmic art, creating scripts for software. The system introduced by the artist applies mathematical operations to a given data array.

Conclusions. Now the process of mutual influence of modern creative technologies and art (the artistic component) is reciprocal. The interpenetration of technologies, even purely mathematical and cybernetic, and the world of art occurs: on the one hand, the influence of technology on art gives rise to new technological forms of art (electronic music, computer graphics, digital painting, etc.), based on a computer method and have an artistic orientation, on the other side, the study confirms that the world of computer science is dependent on art. The study of the compositional structure of musical works and paintings as a mathematical regularity of certain sounds (colors) repetition formed the research of many outstanding mathematicians (Norbert Wiener, Andrew Markov, and Peter Novikov).

New digital art is born at the intersection of artistic creation and technological means. In this context, a complex cultural problem is being formed; opportunities and relationships are still being formed. Great prospects are opening up for the use of computing and cybernetic machines, primarily in the field of musical theory, analysis, training, propaganda. Today it is already clear that the cybernetic machine can help a lot, but, of course, it will not replace artists, just as it cannot be assumed that it will ever completely replace scientists.

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