Interdisciplinary Studies of Complex Systems
No. 18 (2021) 5–14

https://doi.org/10.31392/iscs.2021.18.005 UDC 502.22:57.08:[004.312.26+004.383.8]

Methods of decoding data using biological research and artificial intelligence in culture practice

Tetiana Sovhyra[1]

Abstract. The article is a comprehensive analysis of projects aimed at studying AI technologies and culture interaction. The author examines the specifics and uniqueness of art works created through AI-technologies using examples of projects from "ThoughtWorks Arts Global Research", "Innovation Laboratory of New Technologies", "Isolation Foundation" and "IZONE Creative Association". The article analyzes the principle of selection of materials, algorithmic analysis of data, the interdependence of digital data received from the user's brain impulses with audiovisual content, the possibility of instant data processing in the process of creating an artistic product. The author explores the principles of tracking brain function and decoding human genetic data, which are used to create art projects. The article assesses the potential that AI possesses and explains the conditions necessary for the implementation of AI-technology in culture. As a result of the study, the author revealed that through algorithmic analysis it is possible to transform digital data into a system of expressive signs of visual and sound arts, to broadcast the received audiovisual content. The author finds out that through these technologies it is possible to create interactive art forms (interactive film, installations, immersive presentations, etc.).

Keywords: AI-technology; algorithmic analysis; tracking; digital culture; artist; immersive theatre

1 Introduction

In the process of technological progress, new technical devices and tools are created in order to exceed the natural capabilities and human strength, in order to curb the benefits of nature. The results of the technical evolution are really impressive: the car moves faster than any Achilles; airplanes and helicopters fly faster than birds; ships, radios, satellites, the latest gadgets — this does not surprise us anymore. Modern nanocomputers can perform certain algorithmic calculations and combinations faster than humans. However, all technical devices are human controlled. That is the strength of the human mind, it is able to create such results of mental activity that are millions of times higher than the physical capabilities of man.

[1] Kyiv National University of Culture and Arts, Ukraine.
STIsovgyra@gmail.com, https://orcid.org/0000-0002-7023-5361

Back in ancient times, there was a need to develop technical devices and sophisticated technologies. The notorious phrase of Archimedes "Give me a point of support — I will turn the Earth" (212 years BC) — confirmation of this.

Due to the overly rapid development of the scientific and technological process, interest in the introduction of technologies in various spheres of life is growing.

However, at present, there is an opinion about the uniqueness of artificial intelligence and the ability to reproduce itself and function without human programming (control). Moreover, the illusion of equating human intelligence with artificial intelligence occurs.

A hypothetical theory of technological singularity appears in the mirror of scientific criticism. This concept is based on the "Moore's Law" — an empirical observation by the scientist Gordon Moore (1965) [12], which suggests that by 2035 the computing power of cyber machines will have exceeded the power of the human brain [20].

One of the founders of the theory of technological singularity was the British mathematician Irving John Goode. In the 1960s he suggested that very soon an ultra-intelligent machine will be invented — a machine that can far surpass the intellectual activity of any person, no matter how smart it is" [12].

According to supporters of the "techno-singularity" concept, the generation of artificial intelligence and cyber machines will lead to the improvement of the technical and technological production component (machines can self-repair, perform certain manipulations faster and better than human activities).

The so-called "intellectual explosion" is possible in the near future. V. Vinge predicts that the emergence of artificial intelligence, which can dominate the human in the functional component, will occur within the next 30 years. The author argues that singularity is an inevitable consequence of people's natural competitiveness and the development of technology capabilities. If you believe the critic's statement, this event should take place before 2023 [29].

E. Drexler (1986) agrees that "superhuman mental abilities will be available in the near future, but, in his opinion, such formations pose a threat to society" [8]. Therefore, Drexler emphasizes the need to establish the boundaries for the development of the such device capabilities so that their results can be safely studied and used.

In the scientific literature, along with the works in which the singularity is interpreted as a result of the inevitable development of modern technologies, a number of thoughts appear that refute the content of this concept [14], [23].

American physicist and computer scientist Douglas Hofstadter indicates that it is the mind that is the feature that distinguishes man from all newly digital organisms [26]. Human consciousness is not algorithmic, and therefore cannot be modeled using a conventional computer [23].

The aim and objectives of the study. As a result of the literature review, certain contradictions appear regarding the determination of the development prospects of modern technologies. Therefore, it is necessary to study the influence of modern technologies on contemporary art and to identify prospects for the further development of technological art and the possibility of using artificial intelligence technologies in art production.

2 Instant data processing and visual content transformation using AI

Now the issue of introducing digital technologies is almost the most urgent in all spheres of human life. Many world organizations (including Facebook, Tesla) compete in the amount of their experimental studies of human consciousness and deciphering emotions through various tracking systems. These developments use the latest artificial intelligence technology, which allows, based on data analysis, to identify a specific algorithmic sequence.

The capabilities of artificial intelligence technology in various fields of activity look very promising. The AI financial services market is expected to grow from $ 1.3 billion in 2017 to $ 7.4 billion in 2022. This corresponds to an average annual growth rate of 40.4%. [9].

According to the 2017 Digital IQ International Survey [25], AI has enormous prospects:

- 52% of financial companies said they are currently making sub-channel investments in AI;
- 66% of respondents indicated that they plan to use AI in their production;
- 72% of people believe that AI will lead to significant advantages for production in all areas of activity in the future.

This experience is actively being introduced in the cultural sphere. Currently, experimental studies are being conducted on the algorithmic analysis of the material achievements of mankind, including well-known artifacts and art works. Evidence of this is the appearance of copies of famous paintings, the creation of proportionally accurate models of architectural structures, museum exhibits, the emergence of virtual museums, etc.

AI is used in the study of human activity, its nervous system, biological functioning and brain function.

Even the first experimental AI-project was aimed at the interaction of artificial intelligence with humans. “Eliza” (1966) is a computer program based on AI technology, the developer is a professor at Massachusetts Institute of Technology Joseph Weizenbaum. “Eliza” created the illusion of a virtual interlocutor. The program seemed to parody a dialogue with a psychotherapist, implementing the technique of active listening.

The appearance of this program showed the ability of artificial intelligence not only to scan the actions of a human user, but also to “adapt” to it.

Therefore, in the framework of this study, it is necessary to analyze the possibility of artificial intelligence technology to interact with the artist in the process of creating an art product, to identify the principles of functioning and AI technology influence on the result of the art process.

The author explores the projects of “ThoughtWorks Arts Global Research” and “Innovation Laboratory of New Technologies”, “Isolation Foundation” and “IZONE Creative Association” aimed at studying the interaction of AI technologies and art. Based on the publications found, the author tries to analyze the specifics of the functioning of the technology and answer the question: is the technology a co-author of an art product.

"ThoughtWorks Arts" (director, senior fellow at Riseba University in Riga, Latvia and Parsons / New School University in New York — Dr. Ellen Perlman) is developing projects aimed at attracting digital technology into the art space, combining the activities of scientists, programmers, computer technology specialists, artists and cultural figures. "ThoughtWorks Arts" helps artists implement technological experiments in the art space, provides their students with $ 10,000 for 16 weeks to develop their art projects. The collaboration of the laboratory with artists gives significant results, while the copyright for the work remains with the author of the project.

One of the "ThoughtWorks Arts"' projects is the interactive installation "Riot" (the developer is the immersive film director Karen Palmer, 2016). The project is based on the creation of interactive video content. Artificial intelligence analyzes the reaction of the face of the viewer watching the video sequence on the screen. According to the reaction of the observer, the video sequence changes. Thus, the artificial intelligence system built into the monitor (screen) interacts with the viewer, adjusts the video sequence to his mood.

The user views at video clips, filmed in the first person. In this way, the illusion is created that the action is developing right now, and the main character is the viewer himself.

The plot is built in such a way that from time to time the viewer needs to make a decision to solve the proposed problem. Artificial intelligence reads information from the user brain pulses and transfers data to the processor, which selects the next video fragment according to a certain algorithmic sequence.

The algorithm sequence is proportional to the identified emotions of the viewer, which are investigated by scanning brain impulses:

Table I: Material selection procedure ("Riot")

Video content	Emotional condition		
	Calm	Anger	Fear
Scene 1	1 C	1 A	1 F
Scene 2	2 C	2 A	2 F
Scene 3	3 C	3 A	3 F
Scene 4	4 C	4 A	4 F

The film is built around several plot variations, which are divided into separate fragments.

Using the example of a simplified system of algorithmic modeling, we will try to track the interdependence of the psycho-emotional state of the viewer with the selection of video fragments using artificial intelligence technology.

The user, when watching the original video, experiences fear — the plot continues with fragment 1F. When viewing the proposed video, brain impulses convey a feeling of anger — fragment 2A opens, the viewer calms down and watches the video 3C, the last fragment indignates the user — the plot ends 4 A.

The example shows that the emotional state of the user is the result of viewing video content and a database to select the next fragment.

As a result, we have the following algorithmic sequence:

$$\text{The original fragment} \rightarrow \text{fear} \rightarrow \text{1F} \rightarrow \text{anger} \rightarrow \text{2A} \rightarrow \text{calm} \rightarrow \text{3 C} \rightarrow \text{anger} \rightarrow \text{4 A}.$$

As a result of the study of the project "Riot", we can conclude that artificial intelligence technology provides the opportunity to create an interactive film, a film in which the viewer co-authored the plot (link to my theses "interactive films"). An interactive film resembles a computer game, but in this case has an indispensable advantage — the absence of any gadgets, joysticks in the user's hands. It creates the illusion that the viewer directs the plot of the film with the help of his emotions, which are read from the human brain impulses.

3 "NOOR" and "AIBO": the interaction of AI and human in immersive theatre

The "Isolation Foundation" and the "IZONE Creative Association", with the support of the US Embassy, have been organizing the project "Incubator" for 6 years (2014–2020) in order to familiarize specialists and artists from around the world, including Ukraine, with the results of technological developments of "artificial intelligence" in cultural sphere. Many experiments were carried out, which in the future can affect the development of contemporary art.

In particular, studies by Ellen Perlman aimed at identifying the possibility of the interaction of artificial intelligence with art. Her "Noor" and "AIBO" projects are based on tracking the work of the brain and attracting artificial intelligence to the art space.

"NOOR" was presented in a 360-immersive theatre. The audience interacted with the performer, viewing her brainwaves, assorted videos and sounds in real time. Data is perceived from the human brain, undergo preliminary processing, as a result of which an electroencephalogram is created: traits and emotions turn into a certain algorithm. The created digital indicators are subsequently transformed into a specific artistic and visual medium (light, color, animation, sound, music and, using more complex and voluminous clouds, heat, vibration, etc.)

Pink bubbles reflect on the screen the emotional state of interest of the actress, red — frustration, yellow — excitement (fig. 1).

Fig. 1. "NOOR", 360-immersive theatre ISEA, Hong Kong, 2016

This is an approximately 20-minute performance. The performer can walk among the audience and interacts with other people. The video obtained on the basis of the performer's brain impulses is broadcast on screens, the music and the soprano voice also change in accordance with the psycho-emotional state of the actress [22].

The "NOOR" project provides for a large number of digital technology specialists, medical personnel, scientists, artists and consists of several stages:

- scanning of the human brain,
- creation of an electroencephalogram,
- algorithmic analysis of the results,
- conversion of digital data into a system of visual and visual signs of visual and sound art,
- translation of the received visual content and playback of sound,
- creating an immersive performance.

Pearlman notes the possibility of instantly transforming data obtained from brain impulses into visual and sound images. This project shows the possibility of the interconnection of artistic content and innovative digital technologies, art and science.

The "AIBO" project also aims to study the impulses of the human brain [22]. Unlike "NOOR", the received data is processed and converted into color images, dynamic video clips and audio. This process of obtaining data and searching for a certain invariant in visual and sound form is extremely interesting for observers and is a spectacle of an exciting theater.

The visual image is broadcast on the performer's costume. Depending on the emotional state of the actress, the costume reflects green colors (positive emotions — joy, laughter, interest), red (negative ones — disappointment, nervousness), yellow (neutral — peace). At the same time, these revealed emotions "launch" the database with pre-prepared video clips and vocals.

Consider the algorithmic interdependence of components:

Table-II: Material selection procedure ("AIBO")

Psycho-emotional state	Emotions	Suit color	Video	Sound
Positive	Joy, laughter, interest	Green	Clip A	Canto A
Pegative	Frustration, nervousness,	Red	Clip B	Canto B
Neutral	Peace	Yellow	Clip C	Canto C

The technology allows you to change content online in accordance with the psycho-emotional state of the user. Using algorithmic analysis and scanning of brain impulses, it is possible to provide certain visual or sound images to the received data.

Thanks to artificial intelligence, it is possible to organize an interactive human interaction with technology and the audience, to create an immersive theater.

Data is processed online, the results are stored on a cloud server. The peculiarity of instant data processing determines the limitless possibilities of using technology in the cultural sphere, in particular in the theater space.

In medicine, in particular in prosthetics, technologies are used to change their physical and mental abilities. At the same time, technological experiments are already known for integrating foreign objects, digital gadgets as a means of self-expression and perception of the world in a completely different way. We are talking about the creative application of artificial intelligence technology in human activities.

An example, the famous British artist, musician, artist and "cyborg activist" Neil Harbisson imported a technological antenna into his body. The artist was born with achromatopsia, or complete color-blindness. Far from a disability, Harbisson considers his natural world-view to be an asset, though he did want to be able to understand different dimensions to sight [7].

Thanks to the antenna mounted in body, he can perceive the desired colors. This happens in the following way. The information received by Neal is read by the built-in gadget from the brain, then — due to the cloud, the data is processed, the colors are converted into the necessary ones and transferred back to the Neal's brain. Thus, artificial intelligence helps a user who is color blind to see the correct color scheme. Information processing occurs instantly thanks to cloud storage.

Cloud storage is a cloud computing model that provides for storing data on the Internet using a cloud computing resource provider that provides data storage as a service and provides management. Data is available anytime, anywhere.

This example shows that artificial intelligence has the unique ability to change not only the color gamut, but also the images of reality, which means to give reality pseudo-truthful images and transmit processed information to the human brain. However, this issue is beyond the scope of our research, so now it remains clear to us that the AI technology can instantly change the received data and edit images due to the cloud storage. The technology resembles SIRI, which is looking for answers to user requests on the Internet.

4 The principle of decoding generic data in art works

We continue to research projects that combine biological, mathematical research with the artists work.

Heather Dewey Hagborg worked with Chelsea Manning and TW to create "Stranger Visions", exploring genetic identify and DNA.

Heather works with the incorrect decryption of genetic data and their illegal collection. She collects discarded gum and cigarettes from Brooklyn streets and analyzes DNA date in a biological laboratory. Based on the DNA data obtained, she creates face masks and prints them in order to show how the faces to which these DNA data belong would look. Thus, Hatbor creates art objects through biological research, artificial intelligence technology and 3D printing. The exhibition "Stranger Visions" was spectacularly released in 2017, garnering worldwide attention.

"I collected hairs, chewed up gum, and cigarette butts from the streets, public bathrooms and waiting rooms of New York City. I extracted DNA from them and analyzed it to computationally generate 3d printed life size full color portraits representing what those individuals might look like, based on genomic research. Working with the traces strangers unwittingly left behind, the project was meant to call attention to the developing technology of forensic DNA phenotyping, the potential for a culture of biological surveillance, and the impulse towards genetic determinism" (Hagborg, Stranger Visions, 2020).

The development of digital technologies, including AI, is observed in all spheres of human activity. Artists are often the first to try to comprehend the new possibilities of digital technology, explore the social consequences of them. This is especially true for the work of avant-garde artists. Sometimes experimental research in the cultural field has a significant impact on the environment. The "Stranger Visions" exhibition attracted the attention of Toronto law enforcement. The experimental developments of the artist Heather Dewey Hatbor formed the basis for further technology for the phenotyping of forensic DNA, a potential theory of biological observation and the impulse to genetic determinism. Only two years after the presentation of the art exhibition, Parabon NanoLabs launched a service, which the organizers called the "DNA snapshot" for the US police.

5 Conclusions

Art reflects its time and its own special location in the world. Today, a person is interested in the issue of his location in a modern technological society, the prospects for technological progress and possible technological singularity. Therefore, artists and cultural figures direct their projects to research the technological component of art, the synthesis of biological, mathematical and artistic research.

The research revealed that due to artificial intelligence technology it is possible:

- scan the human brain;
- perform an algorithmic analysis of the results;
- turn digital data into a system of visual and visual signs of visual and sound art;
- broadcast received audiovisual content;
- put the principle of data transformation into the basis of an interactive art form (interactive film, installations, immersive presentations, etc.).

The author finds out the possibilities of algorithmic analysis to identify a certain ratio of iconic systems of musical and pictorial works.

It is proved that due to the Cloud Storage, it is possible to immediately process the data and transmit the results.

The art projects examined show the possibility of the interconnection of artistic content and digital innovative technologies, art and science and determine significant prospects for the development of digital technologies in the cultural sphere.

Acknoledgements

Author thanks to the scientific consultant, Doctor of Philosophy, Honorary Academician of the National Academy of Arts of Ukraine Serhyi Bezklubenko.

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