AiArt: Towards Artificial Intelligence Art

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Abstract— **With the advance of Artificial Intelligence (AI) applied profoundly into different areas of industries, a growing number of artists have shown great interest in exploring and discovering the potential possibilities of AI in art through embracing the latest techniques, such as neural networks and deep learning. As a result, a new kind of art named artificial intelligence art (AiArt) has emerged, which is a creative activity that combines artists with technical experts, intelligent robots, and audience by using AI as the core medium to create, express thoughts and emotions. The purpose of this article is to define the AiArt as an approach to distinguish it from other art forms and provide new inspiration and direction for art practitioners, theoreticians and scientists, which is related to one of the topics of the conference like "artificial intelligence injected artistic creation". This paper first briefly reviews the recent development of AiArt and then attempts a discussion about the essence and characteristics of this new form of art through analyzing the disciplines behind the AI artworks. Finally, this paper draws the conclusion that the diversification of subjects, the intelligence of the media, and the modernization of expression are the nature of AiArt, which are the fundamental signs that distinguish AiArt from traditional arts, such as painting, sculpture, and digital art. In addition to the creative, historical, and aesthetic characteristics of general art, we suppose there are more four new features in AiArt: synesthesia experience, flowability and changeability, interaction and communication, and penetration and integration.**

Keywords-artificial intelligence (AI); art; artificial intelligence art (AiArt); AiArt essence; AiArt characteristics.

I. INTRODUCTION

It is a truth universally acknowledged that art always has a long-standing, complex and continually evolving relationship with science and technology. As with advanced technologies, some artists will gradually abandon the previous tools they used to create artworks and attempt to utilize the newest inventions as an alternative medium, which has huge impacts on art that is produced, and the way art is perceived and apprehended by viewers [1]. Like the invention of pigments, the printing press, photography and computers, it is believed that AI is a new revolution of technology that will radically alter the way people make artworks and extend our creative potential and imagination [2].

AI is a domain of computer science whose purpose is to explore the limits and the methods of using digital computers to simulate [3][4], extend and expand functions carried out by the human brains, such as obtaining and dealing information through the senses, understanding natural languages and solving a complex problem [5]. Over the past 20 years, with the support of big data and cloud computing, AI has made breakthroughs in key technologies, such as machine learning, natural language processing, speech recognition and computer vision. In this context, more and more artists have keenly captured the applicational prospects of AI technology in the art field [6], and been eager to use AI media to carry out artistic creation without hesitation. Hence, the combination of AI and art has given birth to a new form of art called AiArt, which has its own unique artistic standards and features that need us to research and redefine.

At the same time, theoretical researches on AiArt are far left behind its practices. It is rare that there are few types of research focusing on the ideological and theoretical level of AiArt, but most of the papers are written from the perspective of technique and application. In 1983, a digital artist named Stephen Wilson [7] put forward an anticipation of the future trend for computer art that developments in AI might make artworks created by artists learn from experience and interact with audiences in intelligent ways with human-like sensibilities, and stressed the importance of AI to visual artists who are encouraged to participate in this inevitable trend. Kaifu Li, an AI expert, published a monograph called Artificial Intelligence in 2017, which has discussed the relationship between AI and artistic creation [8]. He believed the artistic process based on AI algorithms is only the simple imitation of a particular creative style of artworks created by artists through learning a lot of human works as a database. Thus, there is no possibility that computers are able to approach or surpass human artists in the next few years. Liqing Tan, a famous artist, has given a bold interpretation and prediction for the development of AiArt in the future and put forward the concept of singularity art [9]. He has discussed the challenges that artists will face when it comes to strong AI and analyzed the nature and characteristics of singularity art and the new type of relationship between artists and the audience. He supposed that singularity art is a high combination of human intelligence and AI when science and technology reach the singularity. Singularity artists are no longer just creators and messengers, but participants and coordinators; experiencers are no longer just external watchers, but also participants and creators. There is no clear distinction between viewers and creators. Some scholars thought that AiArt is more intelligent and autonomous which make them separate

from traditional computer art and it can help to improve the imagination, creativity, perception that computer did not have before [10]. In short, theoretical researches on AiArt which is neither comprehensively nor deeply, has just begun, and requires vigorous improvement and development.

It is generally thought that the practice of AI, which artists use as core medium to create a growing number of intelligent artworks has flourished, and the birth of enthralling artistic robots has shown the fabulous and outstanding ability of imitation [11]. However, what exactly is the AiArt? What is the nature and characteristics of AiArt? What are the principles and prospects of AiArt? Those are the questions that need to be answered urgently from the theoretical aspect with the gradual exploration into AiArt, otherwise, the AiArt practice will develop blindly. Therefore, this article aims to answer the question of what AiArt is theoretically, that is, to find out the essence of AiArt as new features that make it different from other forms of art.

In Section 2, we review briefly AI artworks with the development of science and technology. In Section 3, we discuss the essence of AiArt. In Section 4, we conclude the characteristics of AiArt. It would be a better understanding of this new type of art, the importance of combining computers and humans, and the new relationship between AI, artists, art robots, and audiences.

II. A BRIEF REVIEW ON THE DEVELOPMENT OF AIART

The AiArt has an ongoing and long-standing relationship with the advance of AI technology. The development of AiArt, therefore, has gone through three stages: germination stage, rising stage and popularization stage. Figure 1 explains the three stages of the development of AiArt.
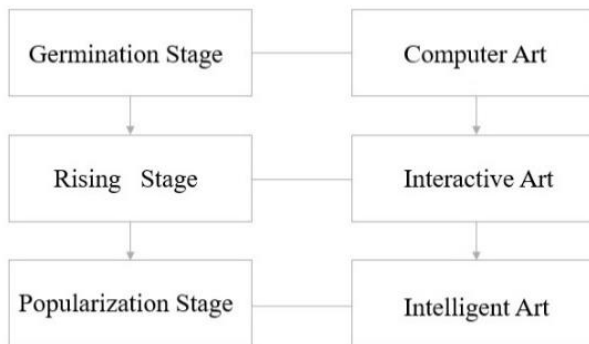

Figure 1.   Three stages of the development of AiArt

A. *The first stage*

From the 1960s to the end of the 20th century is the embryonic stage of AiArt, that is, the stage of computer art. AI is a domain of computer science, thus computer art is the forerunner and foundation of AiArt. At this stage, some foreign artists and art writers have begun to generate artworks enthusiastically with the aid of digital computer programs. They need to conceive the visual art patterns they want in their minds from the start, and then write the corresponding program code to achieve the desired renderings and drawings

of mathematical features. At the beginning of 1960, Desmond Hen, a lecturer at the University of Manchester, used the bomb simulation computer program used in World War II to continuously manufacture the world's earliest automatic drawing machines named the Henry drawing machine [12]. In 1963, the American computer magazine "Computer and Automation" organized the first computer image competition, which ignited the craze for computer image creation. Harold Cohen, an art professor at the University of California, San Diego, is one of the earliest explorers of computer art. He wrote the AARON computer program to create a series of regular images [13]. Figure 2 shows the process of creating artwork by AARON.

Figure 2.   The process of creating artwork by AARON

In 1965, the inventor Ray Kurzweil first composed a piano piece created by a computer that was able to recognize patterns of various musical compositions and use these patterns to create new melodies [14].

B. *The second stage*

From the end of the 20th century to the beginning of the 21st century is the rising stage of AiArt, that is, the stage of interactive art. The landmark event of this stage was that, in 1997, the "dark blue" robot developed by IBM defeated the world chess champion Kasparov in a competition. Since the 1990s, with the invention of human-computer interaction technologies [15][16], AiArt has gradually separated from previous computer art. The AI system in this period can use sensors and other devices to obtain visual, auditory, and tactile sensations. It can achieve human-computer communication and interaction through receiving information from the surrounding environment (including people), and then use text, voice, motion and other information media and sensor systems to output feedback to users [17]. Artist Char Daives constantly explores the combination and interaction of art and computer graphics. In 1990, he created the first "Interior Body Series" art project based on 3D images. In 1993, he created Osmose (infiltration), which allows visitors to explore the mysteries of the world through operations such as breathing and balance in VR [18].

C. The third stage

From the beginning of the 21st century to now is the stage of popularization of AiArt, that is, the stage of cognitive intelligence art. The landmark event of this stage is that Google-developed robot AlphaGo defeated the world Go champion ninth player Shishi Li by 4: 1 in 2016. Compared with traditional computer programs and systems, AI also has learning and analysis capabilities in addition to perception capabilities, which can adaptively adjust parameters and iteratively optimize models with changes in the environment, tasks, and input data [19]. This means that different inputs result in different effects. Over the past few years, approaches to so-called "Deep Learning", one of the most popular algorithms in AI, have started to produce impressive results by simulating the neurons' construction [20].

In 2015, Some researchers from the University of Tübingen combined realistic pictures with artist styles through using neutrally inspired algorithms [21]. In 2016, Deep Dream, a neural network program first developed by Google, was trained by inputting thousands of pictures for image classification and generating artistic images. The Generative Adversarial Networks (GAN) program was designed to make computers learn and imitate classic artworks in history. In 2017, scientists created a kind of independently creative program Creative Adversarial Networks (CAN) program based on the original GAN, which makes the computer no longer simply emulate the activities of human beings, but create artworks by itself [22].

Artists also use cognitive intelligence to "learn" specific aesthetic rules by analyzing thousands of images, and then try to "create" new images that fit their aesthetic characteristics. Artist Harshit Agrawal of Bangalore based in India, input 60,000 human anatomy pictures into the algorithm, created a series of abstract paintings like crimson blizzards, and finally produced works of art with unique aesthetics of AI. Figure 3 shows "The Anatomy Lesson of Dr. Algorithm" of Harshit Agrawal.

Figure 3.   "The Anatomy Lesson of Dr. Algorithm" of Harshit Agrawal
（resource：http://harshitagrawal.com/）

This is also how the Portrait of Edmond Belamy, which was sold at a high price in 2018, was created. Three artists from France "feed" thousands of portrait paintings from 500 years ago to the algorithm program, allowing it to "understand" the characteristics of past portrait paintings, so this seemingly weird artwork was created [23].

III.   THE ESSENCE OF AiART

The so-called essence is the inherent and intrinsic nature of things. It is the built-in prescriptiveness of a thing that distinguishes it from each other, which makes the world diversified and sophisticated. AiArt is an artistic activity where artists, scientists, engineers, art robots and audiences use AI as the core medium to create, express thoughts and emotions, spreading truth, kindness and beauty. The diversification of subjects, the intelligence of the media, and the modernization of expression are the essence of AiArt, which are the fundamental signs that distinguish AiArt from traditional arts such as painting art, sculpture art, and new media art. Figure 4 explains the block diagram of the essence of AiArt.
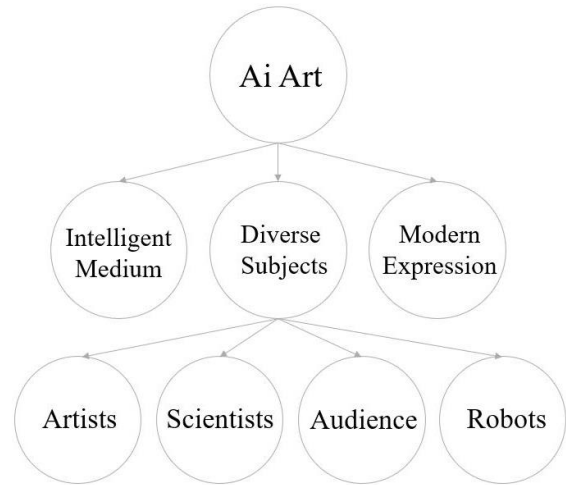

Figure 4.   Bolck diagram of the essence of the AiArt

A. The Diversity of Creative Subjects

In the traditional art creation process, the artist who holds the sole right to speak is the only creative subject. With the development of science and technology, the creative power held by the artist is gradually given to the audience and team members [24]. In the creation of AiArt, artists will be limited by the lack of knowledge of AI expertise and technology, which means that not only artists are able to actively cooperate with scientists who grasp the modern scientific knowledge, but that they should form alliances with AI experts to transform algorithms into artistic information. At the same time, with the advance of AI technology, artistic robots have emerged one after another such as painting robots, writing robots, music robots, dance robots, etc. [25]. They can learn, perceive the world like humans, and carry out artistic creation independently which makes them become one of the creative subjects [26]. In AiArt, the audience can also participate in the process of artistic creation and become one of the creators, as the British artist Roy Ascot has profoundly pointed out that art observers who are audiences are no longer just watch the artworks on the sidelines, or from the outside, but can also

participate in it and become the central figure in the creative process [27]. AiArt not only opens a window for the audience to understand the world, but also builds a door for the audience, and invites them to enter this interaction and transformation of the digital world. Therefore, the role of the audience in AiArt has undergone a fundamental change that they are no longer spectators in the original sense, but participants and creators. In short, in addition to artists, the creative subjects of AiArt also include scientists, AI experts who work with them and the audience.

B. The Intelligence of the Creative Medium

The form of artistic expression is determined by the feature of the media. As McLuhan said that the difference between old and new art is the difference in the use of media [28]. If the same content is expressed in different media, the effects will be extremely divergent. The media not only determines the way and form of artistic expression but also has a huge impact on the nature and aesthetics of artistic works, which indirectly leads to the changes in artistic thinking and concepts. Compared with traditional media, AI media has unparalleled superiority that it can break away from the constraints of time and space, communicate and interact with the audience in a humane and intelligent way, and integrate the virtual world and reality [29]. In addition to those advantages mentioned above, the intelligent media whose image is intuitive can not only convey a large amount of information faster than before but also have a wider range of transmission, which is easier to be accepted by the audience. At present, AI is widely used in artistic creation, whose core position is becoming increasingly apparent. Although digital AI media is invisible and intangible, it plays a core role in artistic creation that controls the overall context of artworks, reveals the ideological content of the work and replaces part of the artist's labor. This is the value of AI as the core medium.

C. Modernization of Meaning Expression

In the past, traditional artworks are usually stored indoors, and the artist's thoughts and emotions are always hidden in the works, which make the meaning expression passive and indirect. In addition to this, the audience must always keep a certain distance to watch and experience. The meaning expression of AiArt, nevertheless, has special advantages. Not only can the creators' thoughts and emotions be directly expressed through computer vision, speech recognition and sensing technologies, but also break through the constraints of time and space to communicate with the audience through network and remote communication technologies; It also has aesthetic and practical value which could meet people's aesthetic and real needs, and integrates the concept of beauty and artistic style into products. Therefore, AiArt which has various functions like seeking truth, enlightening thinking, and recognizing objective laws can not only entertain people, cultivate sentiment, regulate emotions, but also treat mental illness in the future.

IV. THE CHARACTERISTICS OF AIART

AiArt is a form of art, therefore it has the general characteristics of traditional art, such as creativity, historicity, and aesthetics. However, interaction as a product of the combination of high technology and artistic creation in artistic development will be a new direction for AiArt. It has new features that are different from previous art forms. The new characteristics of AiArt are mainly four aspects: synesthesia experience, flowability and changeability, communication and interaction, and penetration and integration. Figure 5 shows the block diagram of the characteristics of the AiArt.
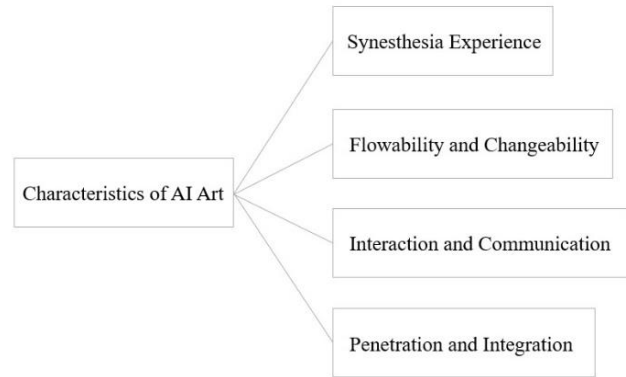
Figure 5. Block diagram of the characteristics of the AiArt

A. Synesthesia Experience

Traditional art is also experiential, but this experience is often single, either a perceptual experience, a visual experience, or an auditory experience that is low-level, superficial, incomplete, and passive. In this experience, the audience's thoughts and emotions about the artworks are incomprehensive, incomplete and superficial. However, the experience of AiArt is full-sense, comprehensive, and omnidirectional. It not only has the perceptual experience, visual experience, and auditory experience but also has a higher level of psychological experience and thinking experience of which the directivity and strong contagiousness can clearly, vividly and comprehensively express the creator's thoughts, emotions and will.

B. Flowability and Changeability

Traditional arts, such as painting, sculpture, and photography are static. They only pay attention to the form and surface but ignore the inner and process of things. However, AiArt that has flowability and changeability is totally different. It reflects the changing process and movement of things. As the British artist, Roy Ascot said that the focus of art has moved from appearance to immanence, which is a dynamic process that moves from the externally visible form to the internal form [27]. AiArt is a kind of infinitely changing art, a flowing art.

C. Interaction and Communication

Interaction and communication are the main features that distinguish AiArt from other art forms. In the future of AiArt,

audience can not only interact verbally and physically with artworks, but also communicate spiritually with art creators and participate in the reconstruction of their artworks. This interaction can be audible or silent; it can be direct or indirect; it can be close or long distance. Artists and participants communicate with each other through the AI medium which transforms the audience from the past "viewers" into "participants". This not only means that the creators are able to get rid of the shackles of the spirit, but also makes viewers have a more open, inclusive, and more diverse interpretation of interactive art creation. The AiArt has broken the boundaries between art and life, the subject of creation and the subject of viewing, making Boyce's "social sculpture" ideal of "everyone can be an artist, and everyone is an artist" a reality. Interaction and communication are the new breakthroughs in artistic expression and the new realm of human aesthetic needs, which make AiArt have more prominent advantages and more vitality than traditional art forms.

D. Penetration and Integration

AiArt will be a highly comprehensive cross-media art that not only integrates various elements such as sound, light, video, image and text but also integrates images with exhibition space, virtual space and real space together. What's more important is that it bridges the gap between technology and art, breaks the boundaries between science and art, and opens up a new way for artists to express their thoughts and emotions. With the development of technology, the connected and non-linear integration of AiArt is becoming stronger and stronger, which may become an imperative methodology that could reconcile different or opposite beliefs, and bring different physical and non-physical entity together with philosophy, religion, and cultural customs.

V. CONCLUSION

After the AI was mentioned at the Dartmouth conference in 1956, its technology and content have been changed continually with the progress of the times. Nowadays, it has been given a whole new meaning by big data and deep learning. Therefore, the potential of AI is once again be inspired. And art has been in the process of continuous integration with technology. The combination of AI and art has gone through several stages of development. Only in recent years has it slowly entered the audience's field of vision, and AiArt starts to show an explosive growth trend with various related art exhibitions and competitions followed. However, the theory of AiArt lags behind the practice of creation, and there is a lack of theoretical journals and discussions on the art of AI. This is still a relatively young research area. Based on this, we have identified the need for deeper understanding of how AI and art interact and how they affect and help each other by analyzing and sorting out the context of the development of AiArt.

Here, we have presented the preliminary results of the literature review, showing in which directions research is being done. We have discussed the nature and characteristics of AiArt, which are the most basic and most important thing. It can define AiArt and distinguish it from other art forms through giving this brand-new art genre a label. We believed

that the nature of AiArt is determined by three aspects, that is, a diverse creative subject, an intelligent creative medium, and a modern expression of meaning; on the other hand, we also summarized the basic characteristics of AiArt from now to the future: synesthesia experience, flowability and changeability, interaction and communication, penetration and integration.

In the future, we hope we will make a progress by trial and error on theories, models, and tools to explore the potential creativity and innovation in AiArt development.

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