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On the Role of Artificial Intelligence and Big Data in Visual Arts

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Abstract

This study aims to explore the role of artificial intelligence (AI) and big data in image analysis research and creation, and propose the leading topic of introducing these technologies -- the construction of tag ring data. In this paper, the concept of AI is discussed, and the trend of image research and the process of image generation in AI are briefly described. In the process of image generation, the role of AI is defined, and it is linked with the concept of AI. This study discusses how image analysis research has developed, and attempts to explore the necessity of utilizing AI and building big data.

Keywords

Creation with Artificial Intelligence; CAN; Visual Arts.

1. Introduction

Thanks to the changes in the network environment, we can easily find all kinds of art works on the Internet. In addition to the fact that a large number of artwork images can be easily obtained, the progress of AI technology has also opened a new era of using image data. AI has shown outstanding performance in image recognition, classification and clustering. These techniques can be used for various image studies. In particular, because quantitative data can be extracted from images and statistical methods can be used for image analysis, making the research on prices and changes in orientation possible. However, in the field of visual arts, the use of image data is still limited. The necessity of introducing a new methodology has not been emphasized because it is limited to the application of a few works (mainly the works of major artists) to education and appreciation. Moreover, the fact that label data has not been established (label data is a prerequisite for the application of new methodologies) will also pose problems in the future.

The research trend involved in this paper is the research findings in the field of computer science. Therefore, they may show the appropriateness and difference of the research methods needed in the field of visual arts. At the same time, new research trends indicate that quantitative analysis methods may be introduced, which is expected to broaden the scope of image analysis in the field of visual arts.

2. The Concept and Essence of Artificial Intelligence

Before discussing the role of AI in the field of visual arts, especially in the process of creation, the first thing to do is to sort out the concept of AI. The misunderstanding of AI originates from the terms for the explanation of AI -- intelligence, unsupervised learning, deep learning, artificial neural network, etc. [1]. These terms create the impression that AI has the ability to think and judge by itself. Russell&Noving distinguished and sorted out various AI concepts, and pointed out the misunderstanding of technology [2]. Russell&Noving put forward four concepts about artificial intelligence, and discussed whether they are consistent with the current technical situation.

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Table 1. A comparison of the concepts of AI

Thinking humanly	Thinking rationally
Acting humanly	Acting rationally

Among these concepts, the first to emerge is the view of machines acting like humans. This was a concept proposed by A/Turing in 1950. It envisaged a kind of machines that could replace human beings. The efforts to develop "technology to replace human labor" in the fields of natural language cognition, image cognition, machine learning, etc. can be regarded as the continuation of this concept. However, as demonstrated by Moravec's Paradox [3], it is very difficult to make humans act like humans in technology and this still cannot be fully realized.

As mentioned earlier, regarding AI as a behavioral agent is the closest concept to the implementation technology at present, which eliminates the misunderstanding caused by words and the imagination of the future. Therefore, to discuss the subject of AI creation or research activities, we should start from the concept of "AI as a machine for reasonable actions". As a technical science, it mainly studies the characteristics and laws contained in human intelligent activities, and then imitates and constructs artificial systems with a certain degree of intelligence on the basis of these characteristics and laws, enabling computers to make use of artificial intelligent systems to complete the work and tasks that previously required human intelligence to be competent. However, due to the limitation of technical means, the strong artificial intelligence allowing machines to have the ability of independent and creative thinking as shown in some films cannot be realized. Currently, the research on artificial intelligence is still in the stage of weak artificial intelligence, focusing on solving problems in some specific areas. With the rapid development in the past three decades, artificial intelligence has been widely applied in language recognition, image recognition, natural language processing and expert systems, and has achieved fruitful results.

3. The Trend of Image Research Through Artificial Intelligence

In the field of image research, the actual use of AI began in 2010. For AI, images are RGB values of pixels [4]. First, RGB values of pixels (i.e. nodes) are arranged in a line [5], and the kernel is used to find random digital patterns [6]. As a digital grid, the kernel derives the composite product of the sum of the products of numbers and node values in the kernel while moving nodes in turn. By repeating these processes, feature map that reduce the number of nodes are extracted, and then the activation function is applied to derive the feature values. The derived eigenvalues are compared with the eigenvalues of the learning data to complete the classification of the unknown values.

After that, the topic of AI image research is transferred to image generation. Due to the high commercial availability of the game industry, film industry and other industries, these fields have become the focus of investment and research of individuals and enterprises. In 2014, Google disclosed the image generation algorithm called Deep Dream. However, as a research achievement of super large transnational enterprises, its image was disappointing. It exposed the limitations of pattern reproduction and was labeled as "weird". This is also the reason for the misunderstanding that "AI cannot create new images". (Figure 1).

Figure 1. An image that Google created through Deep Dream [7]

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In 2014, with the emergence of GAN (General Adversial Network), research on image generation ushered in a new turning point [8]. The development of various application software of GAN -- Pix2Pix, CycleGan, DiscoGAN, etc. -- made image generation more convenient. In 2017, Nvidia introduced artificial intelligence, which has learned 200,000 photos of celebrities. It has the technology to create an unlimited number of non-existent characters. By inputting a simple sketch, it can follow the prompt and create new landscapes and images. (Figure 2).

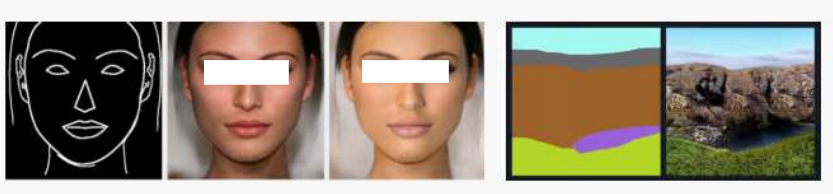

Figure 2. The image generation process of Envidia [9]

In addition, Microsoft's "Next Rembrandt" project in 2016 not only showed the painting style of specific painters, but also perfectly imitated such details as strokes (Figure 3). Based on the image data of 346 Rembrandt's works, the project team completed a new sketch and used a 3D printer to draw Rembrandt's strokes. Whether the facial structure, angle of the characters, or the thickness of the oil painting, the project managed to reproduced the style of Rembrandt's works.

Figure 3. Images and strokes created by the Rembrandt project of Next [10]

4. Artificial Intelligence Creation in Visual Arts: Objects and Tools

The creation of "computer" in visual art began in 1960. Harold Cohen developed a program based on C language to represent the mathematical model on the plane (Figure 4), or made a mobile robot "Turtle" and created works (Figure 5). Turttle was a mobile robot with marks, and could move to target points through the given codes, thus drawing on the plane. The program of coding to find target points reflected the mathematical model and the artist's intention [11].

Figure 4. Harold Cohen, “Untitled”, 1971, printed screen on paper, 66.4*80 cm, collection of Tate Modern Museum

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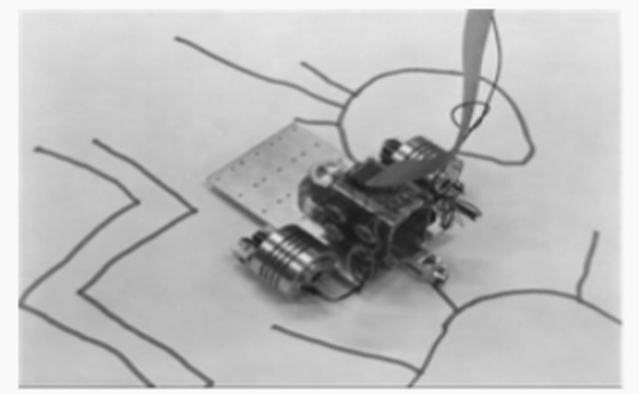

Figure 5. Harold Cohen, the creation model of the "SFMOMA" exhibition framework, 1978, 10.2*12.7 cm, collection of the Computer Story Museum

Recently, the visual arts industry is carrying out a variety of work aimed at surpassing computers and connecting artificial intelligence and creation, not only reproducing the structure of the algorithm or the learning process of artificial intelligence, but also making data processing visual. The coexistence of artificial intelligence and human is shown as the intersection of programming and art, and it shows that the accidental assumption of algorithms can be realized through tools of art.

By introducing new tools such as robots, interactive media and cognitive research, Golan Levin turned sound into form and body into painting, showing them as works. Ghost Pole Propagator II can project the audience's actions intact. It integrates the visualized algorithm of motion silhouette with computer adjusted laser technology to realize the coexistence of machines and humans. "(Figure 6).

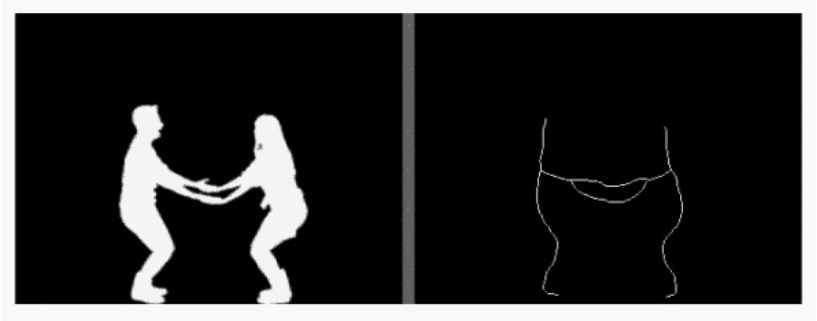

Figure 6. The realization mechanism of Ghost Pole Propagator II by Golan Levin [12]

Compared with such works that actively apply machines or codes to creation, it is more common to objectify artificial intelligence or mechanical civilization. It focuses more on "imagining artificial intelligence and algorithm objects as new aesthetic experience objects, and visually reflecting the connection between data experience and daily sensory experience" [13].

As the second hot topic of AI creation, originality is related to the development of algorithms. In the process of AI image generation, there can be the involvement of the creator, but if there is a copy of the input image in the learning process, the work cannot be regarded as a creative work. The circulation of images in the style of imitation masters has enhanced the convenience of using artificial intelligence, but it cannot guarantee the originality and originality of ideas. The recently developed algorithm CAN (Creative Adversarial Networks) shows that it can prevent the duplication of learning data and ensure originality.

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Like GAN, CAN also has a hostile generation neural network composed of "generator" and "discriminator". If GAN is an algorithm limited to the objective function and aims to create an artificial image in terms of quality completion, CAN can ensure its innovation by adding original evaluation items to the objective function. The images created by CAN do not follow the existing image features, nor do they follow the types of features such as landscape painting and portrait, which ensures the last link in creativity - originality.

5. Analysis of AI in Visual Arts: The Role of Big Data

In the field of visual arts, the analysis and research using artificial intelligence is based on the development of image recognition and classification technology. As the image analysis technology used only in the field of computer science has been applied to the field of visual arts, further research is being carried out, the most prominent representative being the Digital Humanities Institute of Rutgers University. The Institute has a tagging dataset of more than 80000 works. It not only uses AI to study art history, but has also designed CAN, an algorithm of AI creation.

At the same time, researchers try to quantitatively analyze originality. Researchers selected 1710 new images of important works in the art history (66 writers, 13 styles), and analyzed whether the images of more than 80000 works used for style analysis are symbolic and technical similar. The new works used in the analysis are highly similar to any of the more than 80000 works. If the order of the creation period is established, we can speculate the influence of the previous works. Therefore, the lower the similarity, the higher the originality [14]. Of course, the originality of a writer cannot be evaluated only by the characteristics contained in the algorithm. However, it is of great significance to track and analyze the interrelation and influence of writers quantitatively.

Based on these analysis methodologies, CAN, a new algorithm of image generation, was developed. As mentioned in the previous chapter, CAN aims to ensure the originality and quality of images generated by AI. It shows that creation through AI is possible (Figure 7).

Figure 7. Images generated by CAN

Unfortunately, unlike foreign trends of research, there are few domestic cases of applying AI technology for analysis and research in the field of visual arts. The main reason is that no image big data can be used as learning data. The process of collecting materials (especially image data) requires a lot of work and labor, but few artists' working materials are provided free of charge or in the public domain. In order to improve the application of artificial intelligence in the field of visual arts, efforts are still needed to build big data of images centered on domestic artists.

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6. Conclusion

This study discusses the role and potential of AI in the field of visual arts, and points out that the development of technology in the field of image analysis has a great impact on creation and research.

There is no dispute about the role of AI in the field of visual arts. Obviously, AI will not just stay in the field of technology or industry. Many algorithm developers are removing the barriers that hinder the penetration in the field of artistic creation one by one. Technical difficulties can be overcome through interdisciplinary integration and collaboration, but the establishment of label data suite requires efforts in the field of visual arts, especially policy changes in different periods.

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[3] Hans Moravec, Mind Children :The Future of Robot and Human Intelligence, 1988, Cambridge: Harvard University Press, p.15.

[4] is a way to express colors by using the three primary colors of light. The color in the original image is represented as the respective values of red, green and blue light sources, expressed in hexadecimal. Wikipedia website, https://bit.ly/2zudaNQ.

[5] Align the node values into a column to form an input layer. One channel of black and white images forms the input layer, while RGB of color images.

[6] The process of finding patterns is carried out in the hidden layer.

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