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Light and Increasing Time-space Dimensionality of Media in Biological Art

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ABSTRACT
The dimensionality of media, especially artistic media, has shown a slow but clearly increasing trend. As the frontier of contemporary art, biological art is very likely to break the upper-limit of time-space dimensionality in existing artistic areas. Light has rich properties in physical, chemical, and biological aspects，and various hot disciplines are also actively conducting light-related research. In biological art，light express itself exceptionally well, too. When light with such scientific research value meets the lives in biological art, to some extent intervene and impact the existing time-space dimensionality. Based on the above, a few feasible conceptual models of high-dimensional art could be established from three different angles on biological art, which are the actual spatial dimensions, perceptive spatial dimensions, and time dimensions.

Keywords: *high-dimensional art, increasing dimensionality of media, light-related research, media representation.*

1. INTRODUCTION

The dimensionality of Media, especially artistic media, has shown a slow but clearly increasing trend. In the history of human beings, the outlines of media were recognized first, when humans had no sense of spatial depth. For example, the modeling behavior of human beings often starts from painting and then extends to the depth of space, manifested as sculpture and shaping behavior. In the field of digital art, two-dimensional digital images have been realized for a long time. Decades later, the monopoly of two-dimensional images was broken by semi-stereoscopic images that relied on 3d glasses or other external devices. After that, through the unremitting efforts of many digital media technicians, a variety of holographic imaging technologies have been successfully developed. And there are all kinds of new media presentation technologies that are being developed or will be developed.

At present, the upper limit of the media dimension of traditional art is consistent with the three-dimensional space that people can directly perceive themselves eyes. In the field of digital media art, if the superposition of virtual space dimension and real space dimension is considered, the highest dimensionality can be regarded as the enhanced three-dimensional space dimension.

As the forefront of contemporary art development, biological art is constantly rebuilding the boundaries of various meanings of art. A living creature can be the material of biological art, as can a living state. Under the influence of biological art, the old ethics and restrictions are gradually loosened, and the theme of the works of biological art is always beyond people's previous cognition. Therefore, the dimensionality of media in biological art is not necessarily limited by the upper limit of space-time dimensionality in traditional art or digital art.

In accordance with the trend of media gradually ascending in dimensionality, some new media may show four or more space dimensions in the future, which is a direction to explore the possibility of media. And this is possible in biological art because we can see that light behaves in a very unusual way in biological art. In the context of biological art, light is no longer just lighting, imaging, heating, and other common manifestations in the creation of other art fields. It can provide life energy for animals, plants, or other organisms, and can also be organically added to some beings, become a part of their life, and so on. This kind of light is very different. It's no longer as inorganic as it has been in other art forms, and shows a wealth of possibilities. Break through the upper limit of space and

time dimensionality of biological art media, perhaps it will be done by light.

Taking light as a breakthrough point, it is the main research purpose of this paper to explore how to realize the high-dimensional media in biological art. The collation of the expression in the field of light, including biological art, was the necessary step before discussing the higher dimensionality by light, and based on these studies, the conceptual model of more high-dimensional art was created.

Both in the field of art and technology, a large number of practices related to biological art are very innovative reference value and social significance. In addition to its artistic value, biological art sometimes plays a guiding role in the development of new biotechnology, providing bold and unconventional ideas. It can sometimes be seen as an intermediate form between biotechnology and its application, pointing out constructive directions for the effective application of the technology, and can quickly obtain certain problem feedback.

2. METHODS

In this chapter, the research methods have used in this paper will be described.

2.1. To characterize the light in biological art by analysing the logical structure of representative works

By disassembling the logical structure of biological art, light in biological art has been compared with light in other art forms and other disciplines from multiple perspectives, to find the special meanings and expressions of light in biological art.

2.2. To search for possible connections between light and dimensions through literature review

About light, there is a large number of basic research in physics, chemistry, biology, and other disciplines, and in recent years, there are a large number of research achievements in neuroscience, communication technology, graphics, and other fields. Through the literature research related to these contents, some dimensional-related concepts or achievements have been found.

2.3. To build the conceptual model of high-dimensional biological art

Based on the specific performance of light in biological art and the correlation between light and dimension, this research reasonably analyzed how to realize the high-dimensional media in biological art. Then all the ideas were sorted out, and the feasible conceptual models were drawn into diagrams.

3. RESULTS & DISCUSSION

This chapter will describe the research results of this paper, and parse it properly.

3.1. Organic characteristics of light in biological art

Light has shown a lot of subversive artistic and non-artistic values in biological art works, which should be the result of the collision between light and organic lives in biological art. What distinguishes biological art from other art forms is that it involves more or fewer beings.[1]

3.1.1. An artistic expression related to life

As different design languages, different kinds of light are expressed in different works of art, and in biological art, the expression of light is often related to life. Some of it was been in lives, and some of it was to express life, such as the fluorescent rabbit named Alba by Eduardo Kac. The fluorescence of Alba is caused by splicing the green fluorescent proteins into its genome when it was just an embryo. Since Alba makes light on its own, such fluorescence is a new kind of artistic expression. the fluorescence will grow and die with the rabbit, therefore the light from this kind of fluorescence is alive, organic and capable of dynamic change.

3.1.2. An energy source for life

Most of the subjects or materials of biological art are beings, especially the plants which depend on light for growth or order life. Almost all the biological art works involving plants are dependent on the support of light. For example, if the hybridization of Irises by George Gessert wasn't photosynthesizing all the time, it wouldn't be able to stay alive.

3.2. Basic properties of light related to dimensions

In the fields of physics, biology, and chemistry, there are a lot of early basic researches and mature theories on light, can be used for further exploration of light research.

3.2.1. The source of spatial perception

The human visual system perceives depth of space based on the differences of colors, and the fact that people can distinguish different colors is that they receive different kinds of light[2]. It is well known that different colors of light are waves of different wavelengths. Color is not a property of waves, but

rather the result of the different wavelengths received by the visual system. Therefore, we can also say that the depth of space, the third dimension of space, is a perception of light generated by our visual system.

3.2.2. Unbeatable in speed

First of all, the speed of light is considered the limit speed of relativity, and in theory, when objects reach the limit speed, space gets shorter, time slows down. In other words, the dimensions of space-time change, in that case, we haven't been able to prove that yet. In addition, due to the absolute speed advantage of light in transmission, many researchers make use of this characteristic to improve the speed and efficiency of information transmission, such as optical fiber technology. This is why optics has an unassailable place in the field of brain-computer interfaces.

3.2.3. A living time maker

When we look at the works of biological art from the point of view, we feel that they share a single dimension of time with us. But from the point of view of the possible future of the works, the answer may be different. Most of the works of other art categories are inorganic, and their time dimension is also mostly linear. The diversity of interactive art works is because people who participate in interactive behaviors are alive. In the process of interaction, human behaviors are not completely controllable. In the art of digital programming, random behavior is due to a function called random defined by someone. However, when light is used as biological energy, plants and animals depend on the energy to grow. The growth of organic life cannot be completely programmed. When the result is no longer unique because of the growth of organisms, the time comes to be alive and no longer one-dimensional. Multidimensional time is the basis of the multiverse.

3.3. Recent research based on light and spatial dimensions

3.3.1. Google's light field display [3]

The light field is the amount of light that flows through each point in each direction. The effective use of light field technology can realize the simulation of human eyes to obtain spatial information. Google has successfully used light field technology to develop a device named Starline, which enables the transmission of extremely realistic real-time dynamic portraits over long distances.

3.3.2. Spectral polarization imaging（SPI）

By simulating the SPI elements contained in mantis shrimp, a new photodetector has been designed. The new detector can register four spectral channels and three polarization channels simultaneously, which could detect more spatial information of more dimensions compared with traditional 3D detectors.[4]

3.3.3. A prototype of wearable brain-imaging device

Optical imaging technologies cover several technologies, such as calcium imaging and optogenetics. Optical imaging technologies, in conjunction with genetically encoded sensors and actuators, serve as important tools toward these goals, allowing access to large-scale genetically defined neuronal populations[5]. Inscopix nVista, a plug-and-play wearable brain-imaging device， has recorded the population of neurons that exhibited calcium dynamics selective to the direction of reach successfully.

3.4. The possibility of increasing the dimensionality of the media in biological art by light

Several conceptual models of high dimensional media that might be applied to biological art are presented below.

3.4.1. Increase the dimension of the media in reality

Theoretically, light does not interfere with each other, which means that it is possible for a position in the three-dimensional space to achieve the recording and expression of high-dimensional position values by the overlapping light waves (Figure 1A). When the eyes capture overlapping channel information, they can consider using external devices to assist or modify the eyes so that they can capture information in dimensions other than three (Figure 1B). To complete the final cognition of higher-dimensional media, the brain needs to create higher-dimensional concepts, and then it can recognize the new dimensions (Figure 1C).

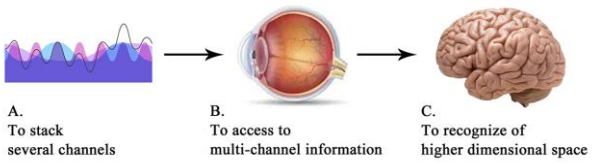

Figure 1. Getting extra dimension in reality.

3.4.2. Sending high-dimensional image directly to the brain by Brain-computer interface

It is difficult to change the original visual system, especially to change the cognition of the behavior of seeing. However, it may be more feasible to directly

change the channels for people to receive spatial information and to replace the shape of the space felt by eyes with a brain-computer interface. In order to define how the information of the extra dimension(s) in higher dimensional space will be expressed. Then the high-dimensional image that you want to transmit should be made in a defined way by a computer (Figure 2A). In order to realize the transmission and acceptance of high-dimensional information with a huge amount of data, the brain-computer interface should use the technology of optical transmission and optogenetics (Figure 2B). Finally, the higher-dimensional images can be transmitted directly to the brain (Figure 2C).

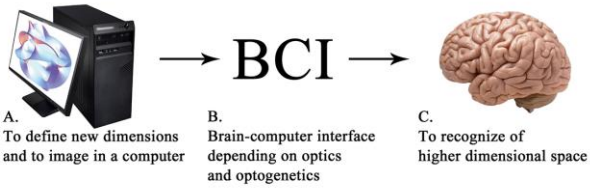

Figure 2. Sending high-dimensional images directly to the brain by BCI.

3.4.3. Output imaginary higher-dimensional space by a brain-computer interface

With improved communications and high-bandwidth interfaces, future optogenetics is expected to achieve data rates of 10 Gbps, capable of recording more than 10,000 neurons. Such high-density recording and transmission advantages will not only be used for information import of brain-computer interface in the future, but also for the information output.

It's always easy to imagine, the difficulty is the output of imagination content. If the techniques of optogenetics are truly capable of supporting the complete output of an imaginary image, the form of high-dimensional art will not be difficult. In the future, optogenetics will be enough to support this idea, and we'll just have to define the expression of high-dimensional images ourselves and imagine the whole image we want to deliver (Figure 3A). Then, this image would be read by a brain-computer interface device (Figure 3B). After that, it can be transmitted again to other people using brain-computer interfaces (Figure 3C), and it also can be output to a computer, and to project higher-dimensional images into three dimensions (Figure 3D). If we use the spectral polarization imaging technology, we can project it directly into the 3D space, and the extra dimension(s) can be converted into other channel(s) information, which can then be stored or captured later (Figure 3E).

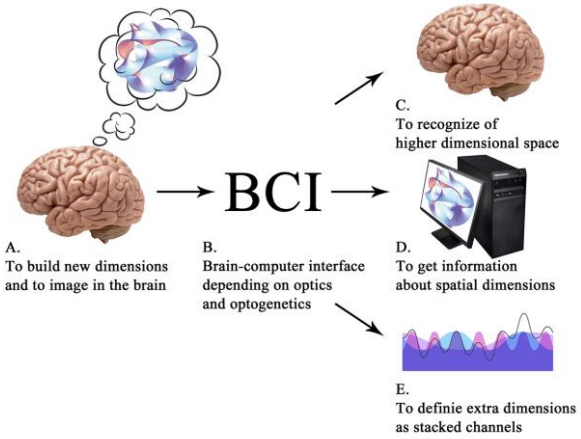

Figure 3. Outputting imaginary higher-dimensional space by BCI.

The second and third conceptual models require appropriate Cyborgization of humans or animals, and cyborgization of biology is also very common in biological art creation. Perhaps it is generally accepted that the limits of non-human perception are easier to expand than the limits of human own, just as the possibility of non-human intelligence is much higher than that of human intelligence. Biological art itself always carries the desire to escape from the confinement of one's physiology[6].

As these conceptual schemes are all provided for biological art, the words such as eyes and brain are not limited to people or animals. The world in their eyes or brains may be completely different from people, or how will animals and plants react if they are exposed to higher-dimensional space-time information? These are all well worth trying.

3.4.4. Organic time in biological art

Organic time can be viewed as multidimensional, and its future can be understood as divergent (Figure 3). In the case of the constant spatial dimension, the future of beings is not unique and full of uncertainty, just like Schrodinger's cat. This is why many works of biological art are fascinating. Time can be more multi-dimensional if there is a bioluminescent organism that produces living light.

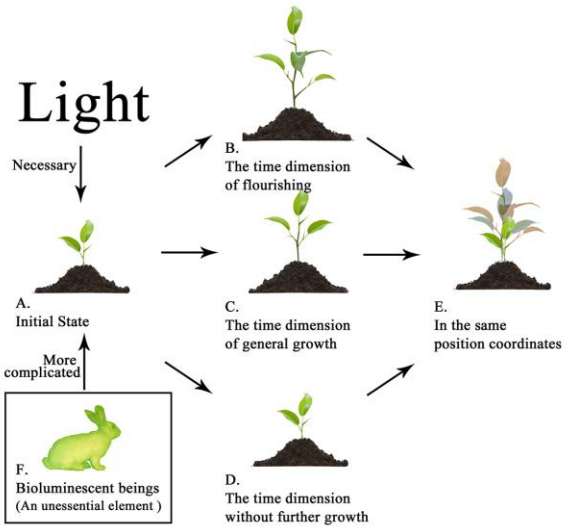

Figure 4. Time dimensions of a plant in biological art.

4. CONCLUSION

In conclusion, light-related research and light-related traits spread across all major disciplines, and light shows a particularly strong influence and possibility in the field of biological art. The upper bound on the dimension of spacetime in biological art will most likely increase. Through the continuous advancement of light-related research and the attempts in this paper, it is believed that it will not be too far away for biological art to realize high-dimensional artistic expression.

ACKNOWLEDGMENTS

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