

On the Application of Digital Media Art and Programming Technology in Public Art

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Abstract. With the rapid development of China's economy, the social environment in which people live is also undergoing rapid changes. Art works in public spaces have also undergone significant changes in their forms and ways of expression, and the combination of art and technology has become increasingly common. This article will focus on the impact of digital media art and programming technology on modern Public art as a starting point, and analyze the application mode, advantages and limitations of digital programming technology in Public art, and then explore the interaction between digital media art and programming technology; In combination with personal graduation design works, the author looks forward to the new forms of expression of interactive Public art in the future.

Keywords: Digital Media; Programming Technology; Gesture Interaction; Projection.

1. Introduction

Technology has been developing with human development since the birth of human civilization. Now we have entered a digital era, in which information technology is the main body, and the influence of technology has penetrated into various industries, including the art field. With the rising status of urban public space, Public art has gradually become one of the most important art forms in this era.

In such a digital era, Public art is not limited to traditional forms such as murals and sculptures. More and more Public art is combined with science and technology to produce many new art forms, from combining with new media such as sound, light and electricity to now NFT is popular all over the world. People's appreciation of art has gradually expanded from the material level in the past to the virtual digital level. In this era, the combination of digital media art and Public art has become the inevitable direction of this era, and has also brought new development paths to Public art.

Digital programming technology never existed until humans could not do without it, taking only a few decades. In 1946, Eniac (Electronic Digital Integration Computer) became the world's first general-purpose computer that required program drivers, which led to the development of programs and programmers. Digital programming has officially entered the stage of the times. At that time, computer intelligence could distinguish between 0 and 1 (i.e., negation and affirmation). When calculating complex programs, errors were often made without knowing where the error was, requiring repeated investigation. The advantage of computers was that they ran very fast, so words were later used to represent the running mode of computer programming languages.

Later in the Internet Age, more programming languages were developed, such as python, java, etc. At first, digital programming was only used for website construction, but in today's information age, people's lives are inseparable from digital programming, such as various programs on mobile phones, smart homes at home, and various software on computers, allowing humans to control things with just a click. Nowadays, our lives cannot do without digital programming.

2. Embodiment of Digital Programming Technology in Public Art

2.1 Opportunities for the Combination of Digital Programming Technology and Public Art

Since digital programming has such a wide range of applications, why cannot it be applied to the field of art?

Digital programming technology has been widely used in electronic devices. As mentioned earlier, in the Internet Age, digital programming has been applied to computer programs. For example, in PhotoShop, images are processed, that is, through a series of operations with the mouse, to achieve the effect of changing images. This series of operations can be seen as a process of "receiving processing executing".

Nowadays, the combination of art and electronic devices is becoming increasingly common. With the development of Public art today, many works integrate new elements such as sound, light and electricity, which can achieve the desired effect through the preset of digital programming language. For example, a stage light can be changed in color, angle, and lighting style under specific conditions through a pre-set programming language. So, by integrating programming languages with corresponding sensors, the goal of changing lighting through human action can be achieved. After digital programming technology is involved in Public art, viewers can interact with Public art works, and their interactivity can be greatly improved.

2.2 Application Mode and Interaction Form of Programming Technology and Interaction Program in Public Art

Sensors are the key to the interaction between viewers and Public art works. There are many such sensors, such as infrared sensors, pressure sensors, sound sensors, and so on. Human voice, temperature, and related audio, video, and other information can be converted into data and applied to programming programs. And the actuators are not only projectors, but also motors, LED light strips, and so on. The actions of a person can not only affect the changes in the projected image, but also affect a mechanical action, such as the brightness or flashing time of a light strip. This enables all things to interact through such a "receive process execute" mode.

Sensors are responsible for converting human activities into program data. Sensors convert "human data" into "sensor data", and then convert "sensor data" into "computer data" through numerical programming program operations. After processing by computers and corresponding actuators, "computer data" is transformed into the effects that can be achieved by actuators, including but not limited to projection images, motor operation Laser emission and so on.

Taking the Leapmotion gesture sensor as an example, it has a camera that analyzes the coordinates of the human hand based on the images it captures. It establishes a coordinate system for the captured images, considers the movement and changes of each joint of the human hand as changes in their orientation in the coordinate system, and generates corresponding data to be transmitted to the programming file. Then, through the processing in the programming program, the data of the human hand is linked to the data of the screen, so that the actions of the human hand have an impact on the screen.

Through various sensors with different sensing methods, interaction between Public art works and the audience can be achieved. The audience can transform body movements into visual, olfactory and other feelings, so that Public art works can form a good interactive relationship with the audience.

3. The Artistic Expression of Digital Media and Programming Technology in Public Art

3.1 The Richness of Digital Algorithms

Digital programming technology can give Public art works more abundant visual effects. In traditional Public art works, the composition, color and form of works are fixed. In digital media art, these parameters can be changed. For example, in terms of color, the color of the work is adjusted based on the four channels R, G, B, and A. By assigning different values to these four channels, different color changes will appear.

The more parameters are adjusted, the greater the change of a work will be. For example, the work "Virtual Butterfly" by the digital artist Kunhao Lin (as shown in Fig.1), by inputting different texts,

and then performing data calculation, the butterflies of different colors and shapes will finally be formed. All these are random and have no fixed form. This kind of work processed by digital programming has more impact, it has greater attraction and interactivity for the audience.

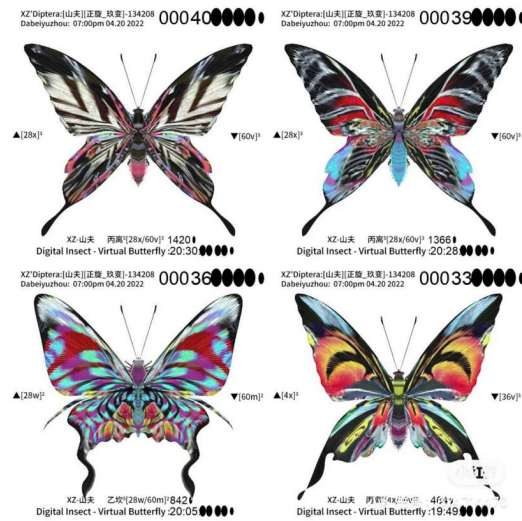


Fig 1. "Virtual Butterfly"(Image from Internet)

3.2 Diversity of Media

As mentioned earlier, data can not only affect changes in the image, but also affect changes in other objects, such as lights and motors. In this way, the limitations of creation will be relatively less, and creators can demonstrate interest, participation, and meet the different needs of participants by changing different media. For example, the American public artist Janet Echelman's work the “Net in the City” (as shown in Fig.2), whose interactive content includes the motor holding the net rope and the light projected onto the net. The differences in media make the changes in works more diverse.



Fig 2. "Net in the City"(Image from Internet)

3.3 Application Scenario of Programming Technology and Interactive Program in Public Art

The interaction mode of Public art works needs to be set according to the number of people in the environment. In areas with high pedestrian traffic, such as subway stations, airports, etc., the variables collected by interaction programs should not be overly precise. The overall density or speed of the crowd should be taken as interaction parameters, and interaction should be carried out through finger touch or other close physical contact; In the field with small flow of people, such as art galleries or other indoor environments, more sophisticated sensors can be used to collect more data, and different interaction effects can be achieved through different behaviors of the audience.

Taking the Shanghai TeamLab Boundless Art Museum as an example, the entire museum's works are presented through digital media, including LED screens, LED spotlights, digital imaging projection, and so on. In places with high pedestrian flow, the interaction method is mostly to change the image through touch or pedestrian flow; In places with low pedestrian flow, such as tea rooms, the image is changed by sensing changes in temperature. (As shown in Fig.3 and Fig.4)



Fig 3. TeamLab Boundless Art Museum Public Area, where people can touch and change the flowers on the walls(Self taken by the author)



Fig 4. Flower image through temperature sensing (Self taken by the author)

4. Advantages and Limitations of Digital Programming Technology in the Application of Public Art

4.1 Advantages of Digital Programming Technology in the Application of Public Art

Firstly, digital programming technology can bring rich visual changes. The sensors mentioned earlier can not only sense people, but also natural factors such as temperature, wind speed, sound, etc. However, a natural attribute often has rich variations. Taking wind speed as an example, when the wind speed changes, its value is often a constantly fluctuating curve (because the wind speed is fast and slow). When such rich numerical changes are transmitted to the computer, through digital programming and actuator processing, a Public art work can be very rich and varied.

Secondly, digital programming technology can bring a strong sense of interaction. When the audience appreciates a traditional Public art work, they often receive a feeling or a spiritual feedback from the art work. For example, a Public art work will give the audience a sense of beauty, an idea of caring for nature, or reflection on a kind of phenomenon. When digital programming is involved in Public art works, all attributes that can be changed can be set to change with the action of the audience. At this time, the audience not only receives a spiritual feedback, but also directly receives a strong impact of visual changes, which will make the audience interested in the Public art works. And then through other actions to make different changes to this work. And this behavior can precisely integrate the audience with the work, better enhancing the interaction between the art work and the audience.

4.2 Limitations of Digital Programming Technology in the Application of Public Art

Firstly, the environment is limited. For example, after digital programming is involved in Public art, its changes are often achieved by lighting, led screen, projection, etc. These realization methods are inseparable from the impact of environmental light on works, and some works need specific materials (such as mirrors, non-reflective cloth, etc.), which often cannot be achieved outdoors, while such Public art works are usually displayed indoors or at night.

Secondly, the software and hardware conditions are limited. Because the focus of Public art works lies in the embodiment of publicity, which requires the works to be placed for a long time and interact with a large number of audiences. In this way, the maintenance of hardware and whether there will be errors in the running process of software are unstable factors, so such works often cannot meet the needs of long-term display

5. The Application of Digital Media Art and Programming Technology in the Author's Work "Organic Interaction"

5.1 Theme Conception

The world we live in now is not just the collection we see in front of us, but the sum of time, space, and human consciousness. We often start from the environment itself to improve and govern ecology and the environment. Although this is the most obvious and direct method, the most important thing is to improve people's thinking and awareness. The most important and essential thing is to cultivate people's awareness of protecting the ecology and respecting nature. The blue and green of this planet depend on people's behavior, and the miraculous craftsmanship of nature is built on people's protection of nature. The protection and development of ecology by humans is also the protection and development of the human species.

5.2 Overview of Works

The author symbolizes the entire ecosystem through visual images of the five elements of gold, wood, water, fire, and soil. Present to the audience through a combination of video and gestures. Through interaction, the audience realizes that they are closely related to the natural environment and the protection of ecology. The audience can control the screen through various gestures, just like human activities have a huge impact on the operation of nature. By making the audience feel this concept, they can have a sense of protecting the ecology and the environment.

The five elements are composed through the mutual transformation of points, lines, surfaces, and bodies, each with its own unique color system and transformation method. At the same time, each element has a strong morphological contrast from the beginning to the end, strengthening the sense of interaction and enhancing the audience's sense of participation, which also conforms to the theme of protecting the ecological environment.



Fig 5. “Organic Interaction” - wood element(Authorship)

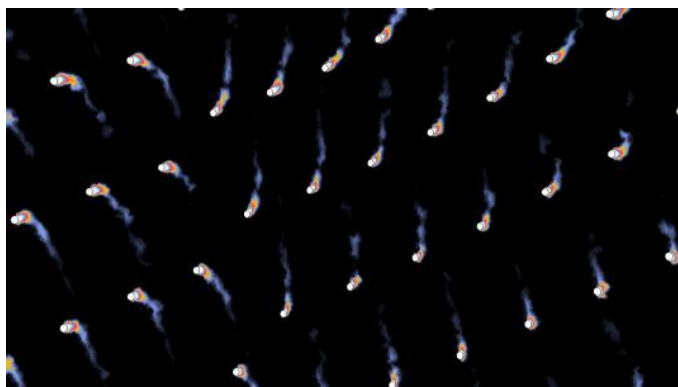


Fig 6. “Organic Interaction” - water element(Authorship)

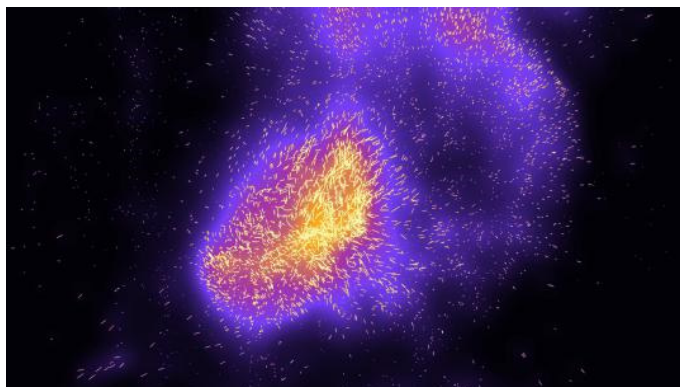


Fig 7. “Organic Interaction” - fire element(Authorship)

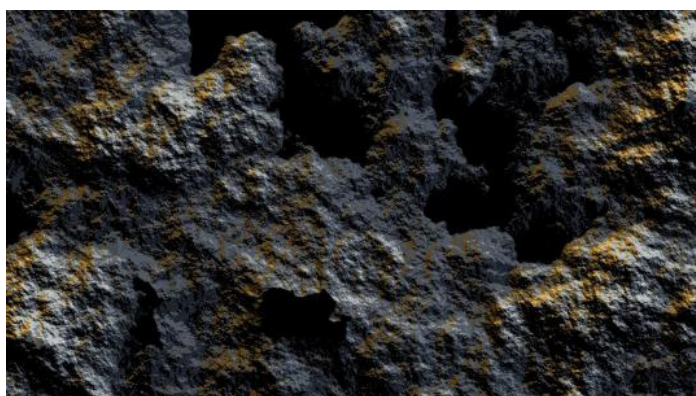


Fig 8. “Organic Interaction” - earth element(Authorship)

5.3 Application of Digital Media Art and Programming Technology in Organic Interaction

As a digital media interactive work, the artwork is composed of five major Chinese elements: gold, wood, water, fire, and soil. Each element has a separate visual system. The gold element is composed of a single metal ball, which changes its form of expression when clenched. The particle effect around the circumference becomes more pronounced during continuous clenching, reflecting a unique metallic luster; The wooden element is composed of a single virtual plant, which further grows through the triggering of movement gestures, thereby changing its shape and reflecting the growth process of the plant; The water element is composed of multiple wave points, and its color and water vapor effect can be changed by triggering a palm gesture. The wave points are rotated left and right by moving the hands left and right, representing the change of water droplets to steam; The fire element is composed of numerous particles, and its condensation effect is changed through a single finger gesture trigger. As the time of sensing the hand increases, Mars will gradually gather, and the color will change from orange red to blue purple. By moving the hand left and right, the position of Mars condensation is changed, reflecting the warmth and publicity of the fire burst; The earth element is composed of a flat surface, and its roughness and refinement can be altered by moving the palm up and down, mimicking the effects of caves and rocks.

In this work, the author uses TouchDesigner visualization programming software to combine with Leapmotion gesture sensing, and controls the image using gesture data collection (as shown in Fig. 9). For example, in the "Fire Element" section, the position of Mars aggregation is controlled through palm movement, and in the "Wood Element" section, the shape and state of the root system are changed through fist gestures.

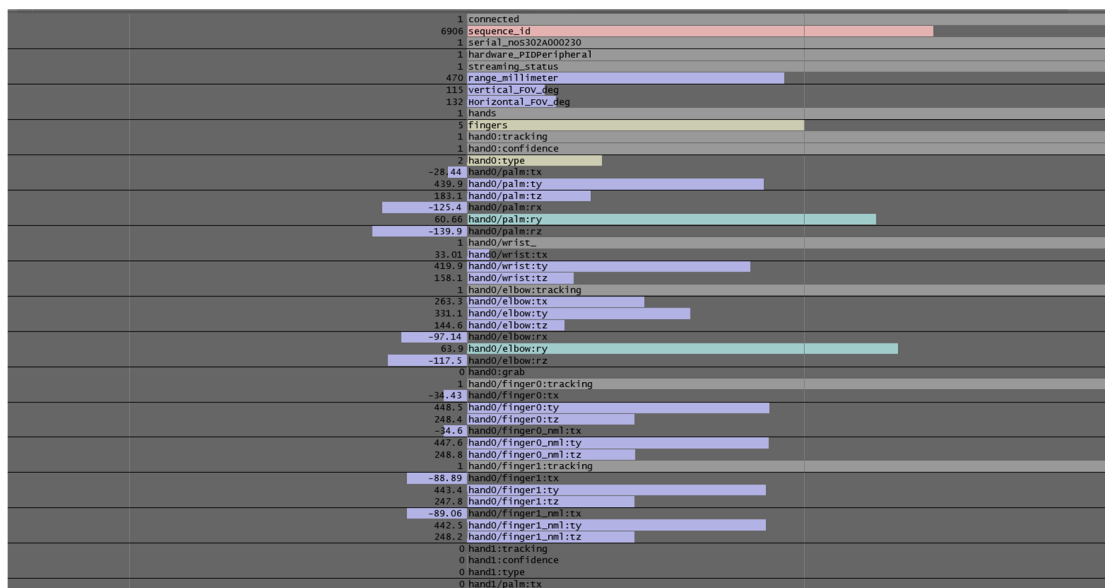


Fig 9. Gesture data collected by Leapmotion. (Authorship)

6. Summary

At present, in the case of digital technology applied to Public art creation, works expressed through projection, lighting, morphological changes and other forms have become the mainstream, while more technologies, such as VR (virtual reality), AR (augmented reality), point cloud technology, etc., will be involved in Public art from different perspectives and depths with the development of science and technology. Although the combination of Public art and digital media is still limited by the times, the development of the times will also catalyze the combination of Public art and digital media. As long as we continue to pursue and explore the means and forms of expression, Public art will certainly be brilliant in the future.

This paper analyzes the changes and impacts of digital programming technology after its involvement in Public art, and it can be seen that the full combination of digital technology and Public art is the inevitable trend of technological development as well as the general trend. With the development and progress of science, digital media Public art will certainly shine in the future.

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