

Augmented Reality and Interactive Devices: Exploring New Dimensions of Public Art

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Abstract: Public art plays a vital role in urban development, which can improve the quality and charm of the city and promote its prosperity and development. Augmented reality and interactive devices are commonly used in the development of urban public art. Interactive device art is an art form that requires the audience's personal participation and interaction. It combines technology and art to bring immersive sensory experience and emotional resonance to the audience. Starting from related concepts, this study explores the application of public art in augmented reality and interactive devices, providing theoretical basis and reference for related development and research.

1. Introduction

Public art has always been an important part of the city's cultural landscape, so it has a strong sense of the times. With the rapid development of digital technology, digital innovation has brought new possibilities to public art. However, there are still some problems and challenges in public art in the city, including funding, lack of participation, sustainability, art selection and quality, social conflicts and disputes, and cultural conflicts and adaptability. To solve these problems, we need the joint efforts of the government, artists, communities and the public to ensure that public art projects can be truly integrated into urban life and culture, and make positive contributions to urban development and social prosperity.

The application of augmented reality and interactive devices in public art makes public art no longer limited to a single form of expression, but develop in a more diversified, dynamic and interactive direction. The application of these technologies not only enriches the connotation of public art, but also improves the audience's participation and experience, making public art a more attractive and infectious art form.[1].

2. Related theoretical concepts

2.1. The concept of augmented reality

Augmented Reality (AR) is a technology, which combines the information in the real world with the information in the virtual world. AR technology is effectively applied in the real world by carrying

out simulation processing on the basis of science and technology such as computers and superimposing virtual information content. After the real environment and virtual objects overlap, they can coexist in the same picture and space. AR technology can not only effectively reflect the real world content, but also promote the display of virtual information content, which complement and overlap each other (Figure 1)[2].

As an innovative next-generation human-computer interaction platform, AR devices are an advancement in the integration of the digital and physical worlds. In order to welcome the new era of immersive experience and break through the limits of flat vision, all aspects of AR technology need to be comprehensively upgraded, especially display devices, human-computer interaction, spatial perception and computing that are closely related to user experience. The Academy of Information and Communications Technology report "Virtual (Augmented) Reality White Paper (2018)" points out that the complex technologies related to AR can be summarized into five cores: near-eye display, perceptual interaction, content production, rendering calculation and network transmission. [3].(Table 1).



Figure 1: Augmented Reality (AR)/Tickets to the RAW DATA exhibition

Table 1: Core Technologies of Augmented Reality

Near-eye display	Rapid response LCD screen, folding (Birdbath) has been mass-produced, Micro-LED and diffractive light waveguide have become the key exploration direction.
Perceptual interaction	Inside-out tracking technology has fully matured, and technologies such as gesture tracking, eye tracking, and immersive sound field bring a more natural, situational, and intelligent experience.
Content production	6DoF video shooting technology, avatar technology, etc. to further improve the experience Sociability, immersion, and personalization.
Rendering calculations	Cloud rendering, artificial intelligence, and foveated technology further optimize rendering quality and efficiency.
Network transmission	5G+F5G builds a dual-gigabit network infrastructure. Network transmission continues to explore new technical paths such as transmission push, encoding and decoding, lowest latency path, high bandwidth and low latency, and virtual reality service AI recognition.

2.2. The concept of interactive devices

Interactive installation art is an art form involving audience participation and interaction. It combines a variety of technologies, including sensors, controllers, projectors, stereos, etc., and converts the input of the audience's behavior, sound, light, etc. into visual or audible output. The goal of this art form is to achieve two-way communication with the audience and stimulate emotional resonance. According to the different ways of audience interacting with devices, interactive devices can be divided into many types. For example, the art of sound interactive installation mainly uses sound as input or output, allowing the audience to feel the changes of the installation or express their wishes through hearing. Light and shadow interactive installation art mainly uses light and images as input or output, allowing the audience to feel the changes of the device or create their own images through vision. The art of somatosensory interactive devices mainly uses human motion as input or output, allowing the audience to feel the feedback of the device or control their own state through their limbs.[4].

In addition, there are other types of interactive device art such as temperature, smell and current. Designing a successful interactive device needs to follow certain methods, and the interactive device has a wide and far-reaching application value.(Figure 2)



Figure 2: Interactive devices in cities (MSG Sphere, Las Vegas)

2.3. The concept of public art and existing problems

2.3.1. Concept development of public art

Public art refers to all works of art, such as architecture, sculpture and murals, which are placed in free and open public spaces, to distinguish them from works of art placed in various closed spaces (which may or may not be open to the public). This concept first appeared in the United States, and consciously planned, designed, produced and set up works of art such as buildings, sculptures, murals and fountains in free and open public spaces. It can be traced back to ancient Greece, when sculpture was the main form, such as the Parthenon in the Acropolis in Athens (Figure 3).[5], showing the solemn beauty and Christian piety to religion. During the Middle Ages, sculptures, Romanesque sculptures and Gothic sculptures were typical representatives of public art. The development in each period is restricted by social, political and economic environment. For example, at the beginning of the 20th century, due to the implementation of policies and the improvement of economic level, people's minds became increasingly open and their awareness of exploring new things increased, so the forms and themes of public art became more diversified.



Figure 3: Parthenon

2.3.2. Problems in Public Art

(1) Lack of funds: Public art projects usually need a lot of financial support, including the creation, installation and maintenance of artworks. This may be a challenge for some cities with limited financial resources, resulting in limited quantity and quality of public art projects.[6].

(2) Lack of participation: Some public art projects may lack interaction and participation with the public. If the public can't understand or participate in the works of art, public art may not achieve its expected effect and can't really integrate into the life and culture of the city.

(3) Sustainable development: Public art projects need long-term maintenance and management to ensure the preservation and exhibition effect of works of art.. Without effective management mechanism and financial support, works of art may be damaged or declined, which will affect the sustainability of public art projects.[7].

(5) Selection and quality of works of art: When choosing public works of art, there may be disputes about aesthetic taste and artistic quality. Some people may hold different opinions on some works of art, resulting in different evaluation and acceptance of public art projects.

(5) Social conflicts and disputes: Some public works of art may cause social disputes and conflicts. Due to the theme, style or symbolic meaning of art, some works may cause differences and disputes between different groups, and even trigger criticism and resistance from public opinion.

(6) Cultural conflict and adaptability: Public art projects may face adaptive challenges in different cultures and communities. Some works of art may not be compatible with local culture and values, resulting in low public acceptance.

3. The way of augmented reality and interactive devices in public art.

Augmented reality (AR) and interactive installations have revolutionized the world of public art by infusing it with technology-driven experiences. These mediums enable artists to engage audiences in innovative ways and transform public spaces into immersive art environments.

AR enhances public art by overlaying digital elements onto physical works. Viewers can use AR-enabled devices like smartphones or glasses to interact with sculptures, murals, or installations. For instance, an AR app might allow users to see a historical figure come to life in a mural or interact with virtual creatures in a park sculpture. This interaction not only engages viewers but also extends the narrative and meaning of the artwork[8].

Interactive installations go a step further by redefining the relationship between people and public spaces. These installations often integrate sensors, touchscreens, and other technology to create dynamic, participatory experiences. For example, an installation might react to a viewer's movements, allowing them to shape the art's appearance or sound. Such installations blur the lines between creator and audience, making everyone a participant in the artistic process.

These applications transform urban landscapes by adding layers of digital art and interactivity to the physical world. They spark conversations, foster community engagement, and make art more accessible to a broader audience. AR and interactive installations represent a dynamic fusion of art and technology, shaping the future of public art and enhancing our collective experience of public spaces.

4. Advantages and disadvantages of augmented reality and interactive devices in public art.

4.1. Advantages of Augmented Reality and Interactive Devices in Public Art

The advantages of augmented reality and interactive devices in public art are mainly reflected in enhancing interactivity, providing immersive experience, expanding forms of expression, realizing cross-media innovation, improving flexibility and reducing cost-effectiveness. The application of these technologies makes public art more contemporary and attractive, and provides the audience with a better public art experience:

Interactive: Augmented reality and interactive device technology can make public works of art more interactive. The audience can interact with the works and participate in them through touch, sound and light, so as to realize the interaction with art and enhance the audience's sense of participation and experience.

Immersive experience: Through augmented reality technology, the audience can experience the artistic effect of virtual and reality, and get a more immersive experience. This kind of experience can make the audience feel the charm and connotation of public art works more deeply.

Expanding expression forms: Interactive device technology can make the expression forms of public works of art more diversified and innovative. These devices can capture and transform the audience's behavior, create a variety of display effects, and expand the expressive force and appeal of public art[9].

Cross-media innovation: Augmented reality and interactive devices can integrate different media and forms of expression, break the boundaries of traditional art and bring new artistic experience to the audience. These technologies can realize cross-media innovation and make public art more attractive and contemporary.

Flexibility: augmented reality and interactive devices are not limited by the venue and can be flexibly set up and used. These technologies can be used not only indoors, but also outdoors, making the display of public works of art more flexible and diverse.

Cost-effectiveness: Compared with the problems of high production cost and difficult maintenance of traditional public art works, augmented reality and interactive device technology have higher cost-effectiveness. The production cost of these technologies is relatively low, and the works can be updated and iterated quickly.

4.2. The disadvantages of augmented reality and interactive devices in public art

The disadvantages of augmented reality and interactive devices in public art include technical complexity, hardware limitation, update and maintenance, user experience, environmental factors and social acceptance. When using these technologies, creators need to fully consider these factors to ensure the successful display and acceptance of public art works. Augmented reality and interactive

devices need to use specific hardware devices (such as smart phones, tablets, sensors, etc.), and the quality, performance and availability of these devices may limit the experience effect of public art works. Augmented reality and interactive devices need to be constantly updated and maintained to ensure their attractiveness and interactivity. This requires a lot of manpower and resources to ensure the continuity and stability of the work.

(1) Technical limitations: Although the technologies of AR and interactive devices are developing rapidly, they still have some technical limitations. For example, AR requires users to experience it through specific devices (such as smart phones or AR glasses), which may limit the participation of some people. Interactive devices need stable power supply and maintenance, which may encounter difficulties in public spaces.

(2) Cost: The development and maintenance costs of AR and interactive devices may be high. This includes not only the cost of hardware and software, but also the cost of design and implementation. This may limit the budget of public art projects.

(3) Accessibility: Although AR and interactive devices can provide unique and attractive experiences, they may not be suitable for everyone. For example, some elderly or visually impaired people may not be able to fully experience these technologies.

(4) Durability and sustainability: Compared with traditional public art forms, AR and interactive devices may be more fragile and more susceptible to environmental factors (such as weather). In addition, these technologies are updated quickly and may need to be updated and maintained regularly, which may become a problem in long-term and continuous public art projects.

(5) Social and cultural factors: In some communities and cultures, people may have reservations about new technologies, which may affect the acceptance and participation of AR and interactive devices in public art.

5. Specific case analysis

There are more and more applications of augmented reality and interactive devices in public art. These cases not only increase the artistic sense and interactivity of public space, but also provide an immersive artistic experience for the audience. The application of technology makes public art more interactive and innovative, attracts more audience's attention and participation, and enriches the cultural atmosphere and artistic experience of the city. At the same time, these technologies also provide artists with more creative possibilities and means of expression, and promote the development and innovation of public art.



Figure 4: Unreal city. Augmented reality art exhibit, 2021

(1) Unreal City is an augmented reality art exhibition co-organized by Acute Art and Dazed Media. The exhibition, held on the south bank of the Thames, features 36 different "sculptures". In this exhibition, augmented reality is used to create immersive art experiences that viewers can explore and interact with through a smartphone app. It works like this: red buoys placed along the riverside

trail indicate the location of the digital artwork. Visitors must install an app called Acute Art on their phones. Point your phone at the area around the buoy and they'll see the digital sculpture appear. Artists include Norwegian Bjarne Melgaard, Chinese Cao Fei, Argentinian Tomas Saraceno, German Alicja Kwade, American KAWS and others.(Figure 4)

If traditional works of art are static, then art in the new age is dynamic; If traditional artistic expression is one-way, then art communication in the new era is two-way. In this new expression, time becomes a key element. Teamlab implements an organic entity created by crystal light that emits an iridescent glow from its center as it moves, constantly merges, and splits. People can walk into the work and feel the changes they have made to the work, even if they touch and step on the work without harming the work, because they will realize that what they are seeing is ordinary water. (Figure 5)

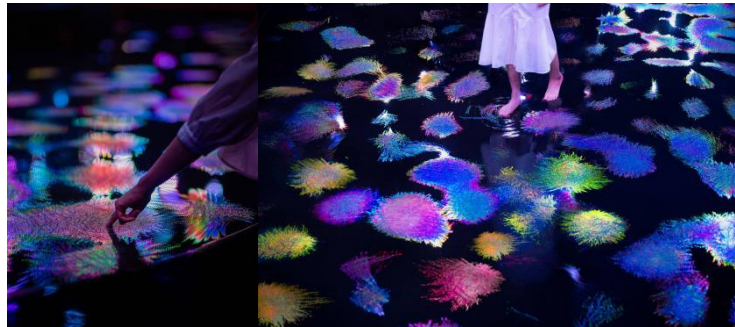


Figure 5: Living crystallized light. Interactive Installation, Teamlab, 2022

Another important and famous interactive installation is the 2003 Danish artist Olaf Eliasson's "The Weather Project", for which the Tate Gallery not only began to welcome visitors to take pictures, but even allowed visitors to eat in the Turbine Hall, in order to simulate the feeling that the artist expected "people to come to this work to enjoy, like lying on the beach for a picnic and basking in the sun". This installation marked a pivotal moment in contemporary art, as it invited viewers to engage with elemental forces in an urban environment. It encouraged introspection and contemplation, making it a memorable and influential work of art.(Figure 6)

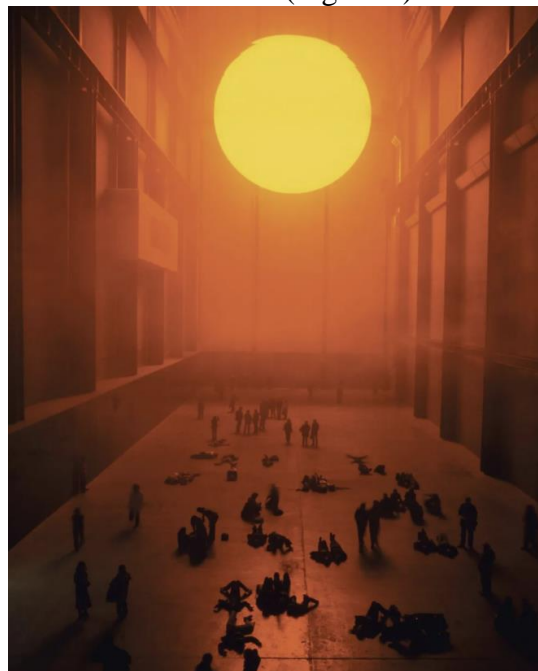


Figure 6: The weather peroject. 2003

In real life, the of TNA team showcased a series of works using augmented reality at an exhibition called "Raw Data" in Xi'an, China. And bring AR technology into interactive installation art, allowing the audience to interact and communicate with the artwork. (Figure 7)



Figure 7: Time and wood. AR interactive installation, 2023

6. Conclusion

AR and interactive devices can make the audience participate in the works of art, which is no longer the traditional one-way transmission, but make the works of art more vivid and interesting through interaction with the audience. The application of augmented reality and interactive devices in public art can not only enhance the audience experience, create interactivity, enhance the sense of participation and expand the expressive force of works, but also realize cross-media innovation and promote the continuous development and progress of public art.

Finally, technological innovation needs to be combined with high-quality artistic and cultural content to present public art works that truly belong to the public. Over-reliance on technology may lead to the weakening of artistic power. Only by embracing digital tools without forgetting to continue to polish artistic value can we find a balance between technology and art.

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