A Research of User Experience on Multi-Modal Interactive Digital Art

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Abstract

The concept of single-modal digital art originated in the 20th century and has evolved through three key stages. Over time, digital art has transformed into multi-modal interaction, representing a new era in art forms. Based on multi-modal theory, this paper aims to explore the characteristics of interactive digital art in innovative art forms and its impact on user experience. Through an analysis of practical application of multi-modal interactive digital art, this study summarises the impact of creative models of digital art on the physical and mental aspects of user experience. In creating audio-visual-based art, multi-modal digital art should seamlessly incorporate sensory elements and leverage computer image processing technology. Focusing on user perception, emotional expression, and cultural communication, it strives to establish an immersive environment with user experience at its core. Future research, particularly with emerging technologies like Artificial Intelligence(AR) and Virtual Reality(VR), should not merely prioritize technology but aim for meaningful interaction. Through multi-modal interaction, digital art is poised to continually innovate, offering new possibilities and expanding the realm of interactive digital art.

Keywords: Multi-modal, Interactive Digital Art, User Experience, Multi-sensory Elements, Sensory Experience

1. Introduction

1.1 Research Background

In the 20th century, the initial formation of the concept of digital art marked the first intersection between the art field and digital technology. With the passage of time, especially in the 21st century, the rapid development of digital technology has greatly enriched the expressive forms of art, making interactive digital art an emerging art paradigm. This art form is no longer limited to the traditional single-mode expression, but presents information and improves the quality of interactive experience by integrating multiple symbol systems (text, image, voice, video, etc.) and interaction methods (touch, gesture, voice, etc.). [1]

In a multimodal context, the experience design of digital art not only pursues visual and auditory stimuli,

but also emphasizes the involvement of tactile sensation and other senses, aiming to stimulate the overall perceptual ability of users. This comprehensive multi-sensory interaction method greatly improves the immersion and interactivity of art works, allowing users to gain richer and deeper feelings during the experience. In addition, the development of multi-modal digital art also reflects contemporary society's demand for personalized and participatory experiences, which not only satisfies the user's sensory enjoyment, but also touches the spiritual level and emotional expression of the experience.

1.2 Research purposes

This study aims to explore the multi-modal interactive digital art in innovative art form's characteristics and its impact on user experience. In the era of interactive digital technology, the transformation of traditional art forms has had a significant impact on user engagement and experience. This paper is based on multimodal theory and explores how multi-modal interactive digital art can provide users with a more immersive and comprehensive interactive art experience by integrating multiple sensory elements by analyzing different interactive art cases abroad. Meanwhile, the study also focuses on the active participation of users in multi-modal interactive environments and their contribution to creative expression. Through research, summarize the multidimensional impact of interactive digital art on user experience under the concept of multimodality.

2. Theoretical background

2.1 The Development of Interactive Digital Art

The development of interactive digital art can be divided into three stages. In the early 1960s, the emergence of computer technology laid the foundation for the development of interactive digital art. The interactive digital artworks of this period mainly used computer graphics and sound as the main forms of expression. In the 1980s, with the continuous development of computer technology, interactive digital art entered a mature stage. The forms of expression have become more abundant, and artistic expression forms with multimedia, virtual reality and other technologies as the core have emerged. After entering the 21st century, interactive digital art has ushered in a stage of rapid development. It began to gradually integrate with other art forms, and new art forms such as immersive art and extended reality art emerged. The development of interactive digital art not only reflects the progress of technology, but also represents artists' exploration and innovation of new media.[2]

Table 1. The Development of Interactive Digital Art

Years	Stage	Expressions
1960s	Early stage	Computer graphics and sound
1980s	Maturity stage	With multimedia, virtual reality and other technologies as the core
After the 21st century	High speed development stage	Integrated with other art forms, new art forms such as immersive art and extended reality art have emerged

2.2 Research on Multi-modal Sensory Theory

The multi-modal theory can be traced back to the 1970s, when American psychologist Albert Mehrabian

proposed the Mehrabian theory of emotional communication through experiments. It was believed that in face-to-face communication, information is usually transmitted in both verbal (7% of speech content) and nonverbal (38% auditory, 55% visual) forms. This idea suggests that during communication, human perception is the result of fusion through multiple sensory channels. When we perceive something, it is not a single sense such as vision, hearing, touch, etc. that is involved, but the result of multiple senses working together. Multimodality is different from single modality. The focus of multi-modal theoretical research is to integrate information through multiple sensory channels to provide users with a complete immersive experience. When multi-modal sensory theory is applied to interactive digital art creation, it usually improves user experience and spiritual needs in multiple dimensions through sensory fusion, interactive technology design, emotional design and other means. [3]

2.3 Research on Digital Interactive Art Forms

In exploring the theoretical framework of digital interactive art forms, researchers usually focus on the dynamic interaction between art, technology, and audiences. German art historian Söke Dinkla once proposed in his research that digital interactive art has challenged the passive way of viewing of traditional art and creates new ways of artistic expression and experience through technological intervention. In addition, the Ars electronica festival held in Linz, Austria, also showed the latest development trend of digital art forms, especially art works involving augmented reality, virtual reality and artificial intelligence technology. These works create a comprehensive and profound experience by combining visual, auditory, tactile and other sensory elements, making the art works an active medium for audience interaction and experience, providing a multi-dimensional space for perception and participation. The interactive form of digital art usually attaches importance to the participation of users and the mutual presentation of moving images and digital information. Stimulate the empathy and artistic aesthetic experience of the experience through multimodal sensory stimulation. [4]

3. Analysis of Multi-modal Digital Art Cases

3.1 Deji Art Museum "Jin Ling Tu"

The large-scale interactive scene installation art "Jinling Tu" exhibited at the Deji Art Museum in Nanjing, originally created by Feng Ning in the Qing Dynasty of China to depict the cityscape of Nanjing in the Song Dynasty, the long scroll of realistic Qing dynasty court customs paintings, "Imitation Song Yuanben Jinling Tu", known as Feng Ning's version of "Jinling Tu", has a high historical and cultural value. The digital installation art "Jinling Tu" on display at the Deji Art Museum, combines traditional Chinese art with modern digital art. Users can create a personal image in the canvas from a first-person perspective according to the positioning bracelet they are wearing, and can follow and interact with the scene elements in real-time. They can also connect to the game world of "Jinling Tu" through the mobile phone program. While appreciating the paintings, users can also integrate into the painting's world.

In this large-scale interactive digital art installation, when users participate in the entire process of interaction, it involves multiple links such as positioning bracelets, smart mobile devices, digital displays, and scenes. By mobilizing the user's sensory system and tracking user positioning, real-time dynamic aesthetics of traditional paintings can be achieved.[5] This artwork provides an immersive experience for the audience while showcasing interactive digital paintings. Enable them to directly participate in and change traditional works of art. The multi-modal interaction mode strengthens the connection between users and artistic works in multiple aspects such as visual, auditory, and body language.

Figure 1. Large digital art exhibition "Jin Ling Tu"

3.2 Stage Art Work 'Hakanaï'

'Hakanaï' is a stage art work created by Adrien M & Claire B, a French company specializing in avant-garde physical and digital performance. 'Hakanaï''s performance combines projection mapping, computer-generated imagery (CGI), and sensors that can detect and respond to the dancer's movements. The dance performance is performed in an immersive environment of moving cubes, and 'Hakanaï' is a real-time animation based on physical motion modeling. After the four-sided performance, the audience is also invited to the stage installation to interact with the dynamic light and shadow effects.[6]

'Hakanaï' creates a real-time dynamic stage for dance performers by integrating multiple sensory elements such as visual, auditory, and tactile senses. With the support of dynamic sensing technology, the body movements of dancers can be perfectly integrated and interacted with the device images. It not only mobilizes the enthusiasm of the audience to enjoy the performance, but also encourages the performers to invest in the artistic performance. The creation of 'Hakanaï' provides a multi-modal immersive interactive experience for both dancers and audiences.

Figure 2. Stage installation art 'Hakanaï'

3.3 'Murmur' Art Installations

The 'Murmur' device is an architectural prosthesis created jointly by Chevalvert, 2Roqs, Polygraphik, and Splank studios. It is an art installation that combines sound and light. When the audience emits sound into the device tube, a series of light patterns will be responded to on the connected wall. The 'Murmur' installation simulates the movement of sound waves to enable communication between audiences and the walls to which they are connected. 'Murmur' Created a two-way communication environment for the audience. Creates a direct connection between the audience's sounds and the changes in light, allowing everyone to create unique light

patterns based on their own voice. This multimodal interaction enhances audience engagement and immersion.

The "Murmur" installation converts sound waves into a Visualization visual art expression form by using technical means such as sound capture and analysis, allowing the audience to see the visual expression of their own voice in an intuitive way. Through the visual effects activated by sound, the audience can experience immediate feedback on their behavior. While mobilizing the interactive enthusiasm of the participants, it can also stimulate their creativity and exploratory spirit.

Figure 3. 'Murmur' art installations

4. User Experience Summary

Multi-modal interactive digital art has become more diverse in terms of user experience due to different interaction methods. In the core concept of "User Experience Design" proposed by Donald Norman in 1995, advocates people-centeredness and advocates that design should arouse users' emotional responses and create a user experience that can provide emotional value through all-round considerations.[7]

In the case of the interactive digital art installation in this study, considering the actual application status of user experience, the design approach has a multidimensional impact on user experience perception from both physical level and spiritual level. Through research, it has been found that interactive digital art cases have the following commonalities in their impact on user experience from a multi-modal perspective: On the physical level, the design usually integrates five senses or multiple senses (vision, hearing, touch), rather than the traditional single sensory mode. Secondly, there is a shift in user status. In multimodal digital art, users are not just Viewers, but also a part of the work, which can mobilize users' physical interaction and engagement. At the same time, specific spatial and environmental elements will also enhance the immersion of the user experience. On the spiritual level, the multi-modal digital art, interactive display method integrates multiple sensory elements to provide audiences with a more immersive and emotional experience. On the spiritual level, the multi-modal digital art, interactive display method integrates multiple sensory elements to provide audiences with a more immersive and emotional experience. Secondly, it changes the traditional display form of art works and spreads the connotation of traditional culture and art in the form of interactive art by crossing cultural and social boundaries.[8] To promote mutual understanding and connection between users from different backgrounds by sharing sensory and emotional experiences.[9]

5. Conclusion

Multi-modal interactive digital art should not only promote interdisciplinary innovation, but also pay more attention to user experience. If modern digital art only emphasizes technology excessively, it goes against the

original intention of digital art user experience design. The multi-modal development of interactive digital art, supported by technological means, should adhere to human behavior and perception as the basic conditions for artistic creation.

Through research, it can be seen that multi-modal digital art is an important development direction for interactive digital art. Multi-modal theory in the practice of digital art through the integration of multi-sensory, interactive design, and emotional design, providing users with a richer and immersive experience, while also allowing them to actively participate in artistic creativity and generate emotional resonance during the experience process. At present, multi-modal interactive digital art focuses more on the interplay of the senses of sight, sound and touch, but this also applies to the input of taste and smell. In the academic research and creation of interactive digital art, it is particularly important to integrate the senses of taste and smell on the basis of mainly audio-visual, and combine computer graphics and image processing to construct an immersive environment based on user experience. In future research, do not just overemphasize technology and interact for the sake of interaction. Especially with the addition of new technologies such as artificial intelligence and virtual reality, the digital art form should convey user experience, perception, emotional expression, and cultural sustenance in a multi-modal interactive way.[10]

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