

Research on Innovative Strategies for Museum Immersive Experience Design based on Somatosensory Interaction Technology

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ABSTRACT

With the advancement of technology and changes in people's lifestyles, the public's demand for public cultural service products continues to grow, and museums have gradually evolved into important places for experiencing technology. Due to the rapid development of motion sensing interaction technology, museum experience forms are constantly evolving. This article elaborates on the relationship between somatosensory interaction technology and immersive experience design in museums, analyzes the advantages of somatosensory interaction technology in museum experience design, and further conducts excellent case analysis. Finally, from the perspective of technology retirement and emotional highlighting, innovative strategies for museum immersive experience design based on somatosensory interaction technology are proposed from three aspects: natural interaction, emotional blending, and barrier free interaction.

KEYWORDS

Somatosensory Interaction Technology; Museum; Immersive; Experience Design; Design Strategy

In recent years, with the rise of "culture+technology", cultural and museum venues have broken through the traditional narrative mode with the help of cutting-edge technologies, such as VR and AI, providing tourists with an immersive cultural and tourism experience and injecting new vitality into cultural heritage. President Xi Jinping has emphasized the importance of centering our efforts on better fulfilling the spiritual and cultural needs of the people, urging us to expedite the deep integration of cultural services with digital technology. Through digital means, we should foster the creative transformation and innovative development of China's fine traditional culture^[1]. Somatosensory interaction technology is one means to achieve this goal. It endows the exhibits with dynamic vitality by capturing human actions, gestures and behaviors. As a key place carrying a large number of cultural relics and cultural heritage, the museum plays the role of a regional education and cultural base. The core task is to establish an interactive dialogue with the audience through exhibits. However, it is difficult for the traditional one-way display mode to meet contemporary audiences' pursuit of a sense of participation and immersion. Therefore, building a two-way dialogue between the exhibits and the audience and continuously innovating the immersive experience of the museum has become a topic of concern for scholars in recent years. Based on this, this paper studies the use of somatosensory interaction technology to innovate the immersive experience design of museums, in order to provide some reference for theoretical research in this field.

1 Overview of somatosensory interaction technology

Somatosensory interaction technology is an interactive way of data transmission and conversion with the help of Kinect, Unity and other technical equipment with corresponding functions by recognizing users' natural behaviors such as gestures and motion states. So as to realize the seamless interaction between people and the digital environment, showing the transformation from technical tools to emotional media. Its unique feature is that no complex operation is required, and any user can trigger interaction through limb action. Combine visual, auditory and tactile feedback to create multi-dimensional sensory stimulation. The core value of this technology is to actively stimulate users' emotional resonance through natural interaction. For example, the use of interactive technology in Museum immersive experience design can increase the audience's knowledge and experience. These designs make technology invisible and let users focus on the experience itself.

2 Overview of immersive experience design in museums

Immersive experience is an interactive form that stimulates the audience's senses in an all-round way through high-tech means and creative design, so that it can be deeply integrated with the experience content in emotion and cognition^[2]. Through the panoramic interactive experience of viewing, listening, smelling and tactile, this design guides

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consumers into a selfless state of high concentration and ignoring the existence of foreign objects, and obtains physical and mental relaxation and a high degree of pleasure in the immersion state^[3]. In the past, museums often used plane projection to display cultural content. Although they can present images and videos, due to the limitation of two-dimensional space, the audience's sense of participation and immersion is insufficient. In order to break through this dilemma, the curators have integrated more immersive exhibitions such as half scene paintings into the digital museum, and combined with real scene elements to make the scene more realistic. Nowadays, with the help of cutting-edge technologies such as sound, light and electricity, the immersive experience design of the museum builds a scene where virtual and reality blend in a specific space. Taking somatosensory interaction technology as an example, it realizes natural interaction by capturing human actions, and the audience can also "Browse" the picture scroll and experience the restoration of cultural relics. This can not only feel the cultural charm, but also break the shackles of traditional display through innovative design and immerse the audience. With the development of immersive communication technology, museums are beginning to apply it to exhibition design, cultural education, and interactive experiences^[4].

3 Advantages of museum experience design based on somatosensory interaction technology

3.1 Multi function -- enhance the interest of education and learning

Somatosensory interaction technology breaks the traditional mode of one-way information output in museums and transforms it into an interactive experience of teaching and entertainment. In the educational scene of the museum, somatosensory interactive games are no longer limited to simple entertainment, but have become a very attractive teaching tool. In different types of museums, you can experience different interactive processes through somatosensory technology. According to statistics, the number of visitors and visitor satisfaction in museums with digital display design are significantly higher than those in traditional museums^[5]. This way of integrating knowledge dissemination and interesting experience has not only stimulated the enthusiasm of the audience to actively explore knowledge, but also greatly improved the retention rate of learning memory through the form of multi sensory participation, making the museum truly a vivid "second classroom".

3.2 Strong interaction -- enhancing the reproducibility of cultural heritage

Somatosensory interaction technology has injected new vitality into the display and inheritance of Museum Cultural Heritage. Through the motion capture and sensing system, somatosensory interactive games can dynamically restore static cultural relics and dusty historical scenes, and realize the deep interaction between people and cultural heritage. During the game, every action and attempt of the audience will be accurately recorded by the system and the corresponding feedback will be made, so that the audience seems to travel through time and space and be in a historical situation. This not only enhances the appeal and vitality of cultural heritage, but also enables the audience to change from passive viewers to active participants, establishes emotional ties, and deepens the audience's understanding and recognition of cultural connotation. The spatial illusion, interactive and hierarchical layout in a targeted, step-by- step manner will enable visitors to be emerged in the cultural atmosphere and they can have interactions with exhibits and for emotional communication^[6].

3.3 Large scope - the universality of expanding the scope of application

With its flexible adaptability, somatosensory interaction technology has greatly expanded the application boundary of museum experience design. Unlike traditional display equipment, somatosensory interactive games have relatively low hardware requirements, and do not require complex professional facilities. Only basic motion capture equipment and display terminals are required, which can be easily deployed in multiple scenes such as Museum exhibition halls, public activity areas, supermarkets, shopping malls and outdoor venues of different sizes and types to achieve multidimensional coverage of cultural transmission. This not only effectively enhances the attraction and uniqueness of the exhibition, but also allows the museum culture to be integrated into public life in a richer form.

3.4 Easy to operate - improve the popularity of the audience

With its simple and intuitive operation, somatosensory interaction technology has greatly weakened the technical barriers between the audience and the museum. Part of the design takes the handle as the main operation tool, with visual action guidance and voice prompts, so that audiences of different ages and cultural backgrounds can easily start, and enjoy the fun of interactive experience without mastering complex operation skills. This low threshold design concept effectively expands the audience of the museum, enables more people to participate in the cultural experience,

truly realizes the purpose of "serving the public" of the museum, and also lays the technical foundation for the museum to create an inclusive and open cultural space.

4 Excellent case analysis

4.1 Planetary ice: the mystery of the ice age

As an innovative non-contact interactive multimedia device in the Canadian Museum of nature, it explores the mystery of the ice age immersion exhibition, as shown in (Fig.1). In terms of natural interaction, the audience can summon the "spirit" in the ice and snow through multiple "circle" gestures, and dynamically present the "magical" pictures of various ancient beasts, so as to establish an intuitive understanding of the ice age in their independent exploration. Through the combination of creative somatosensory design and projection interactive technology, we can jointly interpret the beautiful imagination of the ice age, and use digital technologies such as millimeter glass radar and infrared camera dual positioning to make mammoths and Saber Toothed tigers "live". From the perspective of emotional blending, the visual effect in the interactive screen has grown from scratch. When people start waving gestures, the "particle" effect representing ice elements in the screen gradually fills the whole screen, and finally awakens the mammoth. The more participants, the more significant the wake-up effect. Through rich sound effects and animation effects, the audience seems to travel through time and space to experience the lamentation of mammoths at that time. At the same time, it also reminds us that we must unite, cherish the current natural environment, and protect every life on earth together.



Fig.1 Planetary ice: the mystery of the ice age

Figure source: original wechat official account picture of Shangjing horizon

4.2 Sanxingdui bronze human interaction device

In Sichuan Sanxingdui Museum, there is a Sanxingdui bronze human sense interactive device in the "dialogue with Sanxingdui" interactive experience hall, as shown in (Fig.2). At the level of natural interaction, users do not need to wear any equipment. They just need to stand in the designated sensing area and can instantly trigger the dynamic feedback of the virtual bronze figure through limb movements. Through high-precision motion capture and real-time rendering technology, bronze statues can not only reproduce the user's actions, but also be accompanied by light and shadow changes and scene switching, realizing the "dialogue between man and machine" in the interweaving of reality and reality, allowing ancient cultural relics to cross the boundaries of time and space, showing flexible vitality, but also stimulating users' curiosity and initiative in this interaction, attracting many users to actively try this device for many times. From the perspective of emotional blending, this interactive device gives people an intuitive feeling. When participants witness the "Resurrection" of bronze statues following their own actions, historical relics are transformed from static exhibits to interactive "cultural partners" and quickly establish emotional connection with users. This interactive mode with strong sense of substitution enables the audience to deepen their cognition of Sanxingdui civilization in an interesting experience, stimulate their emotional identification with traditional culture, and awaken their emotional resonance. From the perspective of barrier free interaction, participants only need to stand in the corresponding position, and simple changes such as "waving" or "swinging their heads left and right" can trigger the

interaction, so as to achieve the equal participation of all age groups and different ability groups without complex learning process.



Fig.2 Sanxingdui bronze human interaction device

Figure Source: CCTV news web page video screenshot

4.3 Emotional Theater

The emotional theater is located in an exhibition hall of the National Museum of China, as shown in (Fig.3). From the perspective of natural interaction, the user goes to the interaction platform and controls the two sensors through body movements to wake up the screen in front. In terms of emotional blending, as long as you put your hand on the sensor and connect the emotion in your heart with the sensing system, a dynamic picture of emotional color particles with great visual impact will appear on the screen. For example, the color particles on the choppy sea symbolize passionate emotions, and the calm monochrome light and shadow on the seabed correspond to a peaceful state of mind. At the same time, the screen generates accurate emotion type tags (such as "restraint", "calm" and "tangle") and emotion arousal score (1-9 levels) in real time, transforming Abstract emotions into concrete visual and data feedback. This not only helps the audience intuitively perceive the invisible power in their hearts, but also builds emotional ties through artistic expression, arouses emotional resonance, and realizes the deep value of technology enabled mental health. In terms of barrier free interaction, the standing interactive platform is suitable for people of different heights, with wide sensing area and high sensitivity. Audiences of any age can easily stand on the interactive platform to obtain their own emotional state, so that everyone can not only gain emotional power, but also obtain a sense of participation and achievement.

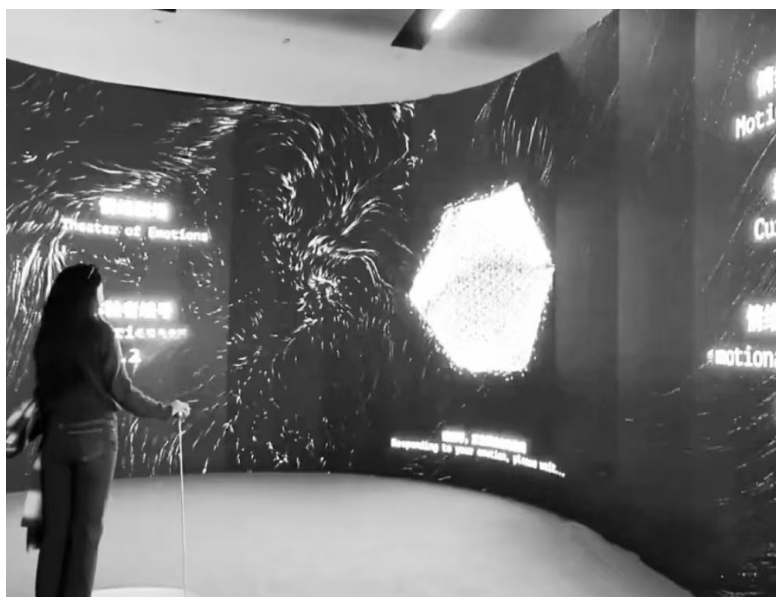


Fig.3 emotional Theater

Figure source: video screenshot of Beijing Tourism Website

5 Analysis on the innovation strategy of Museum immersive experience design based on somatosensory interaction technology

5.1 Natural interaction

In the immersive experience of the museum, in addition to using VR, AR and other technologies, natural interaction should also be used to let the audience actively explore in the natural and smooth experience design. In this regard, some museums use somatosensory interaction technology to break the traditional human-computer boundaries and transform the audience's body language into a natural medium for in-depth dialogue with the exhibits. Based on the intelligent capture system composed of high-precision cameras and sensors, the audience's subtle movements, pace tracks and posture changes can be analyzed in real time and transformed into dynamic "contacts" to drive the narrative of the exhibits. For example, in the National Museum of China, the 20-year exhibition area of the China lunar exploration project, the natural interaction realizes the immersive narrative through the "behavior perception content response" mechanism. After the field experiment, the audience does not need to touch the interactive screen, but only needs to be a little closer to the location of a province on the interactive screen, and the system will automatically activate the interactive interpretation of the province in the 34 provinces of the country based on the location recognition technology, so that the audience can start the exploration journey of interweaving regional culture and Aerospace Science and technology in the natural walk, and quickly understand the local Shenzhou story. This natural action shows the natural interactivity of the experience, and after the trigger point, it stimulates the interest of the audience, so that the audience can better actively touch the interactive screen. In the exhibition area of "eternal life in the mirror - Ancient Chinese bronze mirror culture", in front of the "China Daning" auspicious animal Expo local pattern gilded bronze mirror, the audience can "touch" the virtual work like observing the physical bronze mirror by sliding and rotating with natural gestures, and even feel the subtlety of its technology through zooming operation. In addition, in other museums, some can also adjust the viewing angle by tilting and stretching their limbs, so as to delicately feel the changes of brush texture and light and shadow. With the exploratory stimulation of the audience, the interactive device is more humanized and natural, showing the audience the innovation of Museum immersion experience design based on somatosensory interaction technology, making the design truly a cultural journey dominated by the audience.

5.2 Emotional blending

In addition to natural interaction, it is also necessary to establish emotional ties with the audience to arouse emotional resonance. In the immersive experience, it is very important to establish emotional integration with the audience, which not only enables the audience to experience the emotion of history or a certain atmosphere in the process of interaction, but also drives the audience's emotion and promotes good emotional promotion. Somatosensory interaction technology uses multimodal sensory stimulation to construct intuitive emotional contacts. Relying on computer vision and high-precision sensors, the system uses dynamic light and shadow, three-dimensional sound effects and environmental atmosphere simulation to strengthen the audience's sensory immersion. For example, in the Guangdong Museum of traditional Chinese medicine, the interactive screen of Baduanjin teaching is divided into a demonstration screen and a real-time audience recording screen. The audience imitates through the action demonstration of the master on the large screen, and the system will feed back the action matching degree and action feedback through the real-time recording screen after each action is completed. This not only allows the audience to accurately imitate the movements, but also allows them to deeply experience the breadth and depth of traditional Chinese medicine, feel the positive impact of each movement on the body and mind, and appreciate the charm of traditional fitness methods. This work enables the audience to not only retain sensory memory, but also form a profound understanding of the exhibition theme after the end of the experience, so as to realize the sublimation from shallow experience to spiritual resonance.

5.3 Barrier free interaction

In the design of immersive experience in the museum, we should try our best to achieve barrier free interaction, and ensure that audiences of different ages, physical conditions and technical levels can equally enjoy the immersive experience in the museum. At the operational level, the threshold of participation is reduced by combining simplified logic with multimodal interaction. For example, in terms of touch and vision, when the audience walks into a specific point, it designs interactive games triggered by basic actions such as waving and shaking their head, which are combined with colorful animation feedback to easily integrate into the experience and carry out cultural exploration; In terms of vision and hearing, it provides large font interface, voice navigation and handle assisted operation. Through the "one button" interaction process, help them to participate in the experience without barriers and this interaction is suitable for all groups, better expand the participation, make the immersive experience value of somatosensory interaction technology benefit every audience, and help the popularization and diversification of cultural communication.

6 Conclusion

With the development of virtual reality fusion technologies such as VR and AR, somatosensory interaction will have a broader space for innovation. In the future trend of sustained and high-speed development of science and technology, it is particularly critical to design interactive experience that can arouse emotional resonance and is based on public feelings. This paper deeply analyzes the advantages of museum experience design based on somatosensory interaction technology, and makes a case study, and finally puts forward the innovation strategy of Museum immersion experience design under somatosensory interaction technology. From the perspective of natural interaction, we should ensure to stimulate initiative on the basis of natural flow; From the perspective of emotional blending, it is necessary to establish emotional ties to arouse emotional resonance; In terms of barrier free interaction, we should lower the threshold and expand participation. In the era of digital intelligence, the immersive experience design of museums will show the digital cultural heritage in a more diversified form. This is not just a simple action to wake up the historical scene. When interacting with art works, we feel the civilization temperature across time and space. Each interaction becomes a contact point for emotional resonance, and each experience condenses into a unique historical memory, which makes the culture change from static display to vivid spiritual imprint, and makes the cultural heritage radiate immortal charm with the support of innovative technology.

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