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Research on Multi-modal Scene Design under the Development of Digital Ecological Culture Industry

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Abstract: This article explores research strategies for cultural scene design to enhance the quality experience of the public in the evolution of digital ecological culture industry. This is done through case analysis and experience value quantification of representative digital exhibitions in China in recent years. Based on the analysis results, it is believed that in the construction of digital cultural scenes, attention should be paid to the deep mining of cultural elements and the strengthening of the coherence of overall link design. In the construction of a standard system for deep digitalization and the development of intelligent technology, it is necessary to build deep immersive experience scenes to enhance users' emotional and value experiences. In addition, combining multi-sensory experience cultural and creative products, digital collections, etc. can extend users' perception of cultural scenes and play the long-term function of cultural value dissemination.

Keywords: Digital ecological culture industry, Multi-modal, Strategic experience model, Design strategy.

1. Introduction

With the rapid development of digitization and information technology, the application of digital technology has injected fresh energy into the cultural industry, forming a new format of "culture + digitalization". This has provided new paths for the storage, display, and dissemination of cultural content, promoted the development of market formats, extended the marginal of the industry value chain, and played a positive role in enriching people's spiritual and cultural lives. This article will conduct a user experience analysis based on the strategic experience model of representative multi-modal digital cultural scenes in China in recent years, quantify the experience value within the scenes, and discover the existing problems and optimization directions in the construction of cultural scenes. The discussion and research in this article will focus on the real experience of users, and innovatively formulate evaluation items that are suitable for digital cultural scenes based on the strategic experience model, providing effective observation data for the development of digital ecological culture industry and the multi-modal construction of cultural scenes in the future. It will explore new angles for constructing strategies, helping cultural content to bring immersive and long-lasting experiential value to users in the scene more effectively.

2. Theoretical Framework of Digital Cultural Scenes

2.1. Multi-modal Theory

Multi-modality refers to the integration of various perceptual channels, such as visual, auditory, tactile, gustatory, olfactory, etc., and the use of different media and means to mobilize the subject's multidimensional perception, so that the subject can receive and experience more deeply and immersively in different scenes. Zhang Yongnian[1] focused on the real needs of the visually impaired group, and strengthened the sensory interaction of multi-perception channels in the design of user care product packaging, effectively transforming the visual dimension into interactive channels such as touch, hearing, and smell, providing visually impaired users with more convenient use scenarios; Shen Yue [2] analyzed the spatial construction under the background of media scenarization and proposed the possibility of scene transformation from a multi-modal perspective, enriching the user's multi-channel experience in the scene. The research and analysis of multi-modality are usually carried out from the perspective of products or scenes, aiming to optimize and enrich the user's immersive experience in cultural scenes, thus achieving effective interaction with users. This research has important theoretical and practical significance for how interactive devices can communicate with users and achieve effective interactivity.

2.2. Strategic Experience Model

As an observation perspective, user experience has many analytical methods and decision-making tools that are often used by design teams, becoming important tools for communication and reporting of products and projects [3, 4]. Among them, the Strategic Experience Model is a more universal model proposed by Bernd H. Schmit, which can help designers understand the feelings and behaviors of users when using products or services, and consider these factors in the design process. Its core is to divide user experience into multiple dimensions such as senses, emotions, thoughts, actions, and associations, which are interwoven and mutually influential, together forming the user's overall experience [5]. Foreign scholars such as Jin Jung-hyun [6] used the Strategic Experience Model to analyze customized cosmetics cases, and the research results showed the importance of personal experience, which led to subsequent research imagination and suggestions. Zhang Xiaolei [7] used the Strategic Experience Model to analyze the visual elements of brand experience design on social media through case analysis and explored new possibilities for brand experience design under the sharing economy. Therefore, the subsequent experience dimension setting of this study will be based on the Strategic

Experience Model.

2.3. Digital Cultural Scenes

2.3.1. Digital Ecology of Cultural Industry

The cultural industry itself is mainly based on the production of human spirituality, combined with different material presentation methods and information dissemination forms, to meet people's spiritual needs [8]. Cultural production cannot be separated from subsequent consumption experiences. In the process of transformation, cultural product forms are closely related to the materialization of spiritual content, in addition to using human beings as media carriers. Therefore, in the process of continuous breakthroughs in digital technology, cultural content, as a permeating element and growth factor, has achieved a new state of integration with digital methods, gradually constructing the digital ecology of the cultural industry.

2.3.2. Digital Cultural Scenes

Digital cultural scenes, as a typical path for digital technology to empower the development of the cultural industry, are supported by technology and centered on experience. By expanding the space for cultural consumption, optimizing the supply of cultural content, improving the quality of cultural consumption, and maximizing the release of cultural consumption demand, they promote the high-quality development of the cultural industry [9]. Wu Liyun [9] summarized that digital cultural scenes mainly use new experience technologies such as holographic presentation, high-fidelity, multilingual interaction, digital twins, and cross-time and space to realize integrated online and offline digital cultural experiences. Traditional culture and cultural relic resources are scenarized and productized to provide more rich digital cultural products, allowing cultural content to be more widely understood, perceived, and experienced by the public.

In summary, digital cultural scenes, as an interactive experience situation combining virtual and real elements, emphasize the use of digital technology to mobilize users' multi-dimensional perception in the scene, presenting them with an immersive experience that integrates culture, technology, and senses on a specific cultural foundation.

3. Literature ReferencesDetermination and Evaluation Method of User Experience Evaluation Indicators Based on the Strategic Experience Model

3.1. User Experience Evaluation Indicators

Based on the Strategic Experience Model Although there are differences in the dimension division of user experience in the current academic community, the evaluation indicators or observation items of user experience under the same dimension are similar, and a relatively stable structure has been formed. In order to make user experience evaluation more operable, this article uses the strategic experience model, refers to the quantitative observation items in existing user experience evaluation research, and combines the characteristics and actual situation of digital cultural scenes to select, design, and extract evaluation indicators, forming a preliminary set of evaluation indicators. Through literature collection and induction, six dimensions have been finally determined, including sensory experience, content experience, technical experience, service experience, value experience, and emotional experience.

3.2. Evaluation Method Based on the Strategic Experience Model

To obtain more effective and authentic evaluation data, this study invited eight experts with years of theoretical and practical experience in the field of art and design to form a focus group. They conducted a comprehensive evaluation of each case based on the user experience evaluation questionnaire and held focused discussions. Through in-depth analysis and discussion by the experts, this study obtained more comprehensive and objective evaluation results.

4. Introduction and Analysis of Typical Cases in Digital Cultural Scenarios

Four typical cases in digital cultural scenes are introduced and analyzed in this article. These cases were selected based on their popularity in online discussions. Each case has its own focus and highlights in terms of scene construction, but they all use digital technology and interactive devices to present cultural information to users in a multidimensional and multi-sensory way. This article focuses on introducing the digital technology and interactive device content of each case and uses a radar chart to show their scores after being evaluated by the expert panel.

4.1. Introduction to Typical Cases of Digital Cultural Scenes

4.1.1. "Tiangong Kaiwu" Digital Cultural Creative Immersion Exhibition

The "Tiangong Kaiwu" Digital Cultural Creative Immersion Exhibition is one of the major events hosted by Dianping.com in 2022. The exhibition focuses on the comprehensive scientific and technological work of ancient China, "Tiangong Kaiwu". Through the accurate extraction of cultural connotations and scenes of laborers' production and life, modern digital technology is used to reproduce the greatness of the ancient civilization of the Chinese nation recorded by Song Yingxing hundreds of years ago. The exhibition uses Mappin projection special effects technology as the basis for high-level visual construction, combined with a variety of interactive devices, allowing visitors to experience a fresher immersive sensory experience.

4.1.2. "Patterns Carrying Meanings" - The Palace Museum Tencent Immersive Digital Experience Exhibition

"Patterns Carrying Meanings" is an immersive digital experience exhibition jointly launched by the Palace Museum in Beijing and Tencent in 2022, aiming to showcase the charm of traditional Chinese patterns. It is worth mentioning that there is no physical exhibit in this exhibition. The technology team extracted various patterns from the ancient buildings, ceramics, furniture, and embroidery of the Palace Museum, and presented a digital cultural experience space with stunning visual effects and interactive fun through technologies such as naked-eye 3D, immersive rendering, and panoramic sound mapping.

4.1.3. "Jinling Painting" Digital Exhibition

The "Jinling Painting" digital exhibition was the hottest digital cultural exhibition in Nanjing in 2021, showcasing the

unique charm of the painting known as the "Nanjing version of Qingming Riverside Picture". The exhibition made full use of digital media and audio-visual technology to vividly reproduce the dynamic aesthetics of the ancient painting, while also incorporating elements of IP and game interaction, making it more fun for users to experience the life of ancient people.

4.1.4. Suzhou Museum's Life and Culture Theme Exhibition

Suzhou Museum's unique feature in exhibiting specific cultural themes is showcased through its Exploration Experience Hall and Suzhou Colorful Life Hall. The Exploration Experience Hall is designed specifically for children aged 3-12, not only to teach them about the history of Suzhou city but also to provide them with a rich cultural experience through real-life scenarios and audiovisual and tactile designs. The Suzhou Colorful Life Hall focuses on Suzhou folk customs and the 24 solar terms, using color and objects to vividly depict the dynamic aesthetic of traditional life during these seasonal events. The design and curation philosophy of these two exhibitions aim to provide visitors with a deep understanding of the diversity and depth of Suzhou culture through interactive experiences using multiple senses.

4.2. Results Analysis

Through case analysis and evaluation of the user experience scale for different digital cultural scenes, the comprehensive results are as follows, see Figure 1.

Users are generally satisfied with the sensory experience, content performance, and technological applications of digital cultural scenes, with scores exceeding 3.5 points for each scene, and some scenes scoring over 4.5 points in sensory experience and content performance. However, the performance of digital cultural scenes in terms of service, value, and emotional experience is slightly inferior, with average scores below 3.5 points. Overall, there are significant differences in the performance of digital cultural scenes in different experiential dimensions, and low scores in a few dimensions have also to some extent lowered users' overall satisfaction. Particularly, the low average scores in service, emotional, and value experience indicate that there is still room for improvement in service communication, emotional interaction, and value transmission in digital cultural scenes.

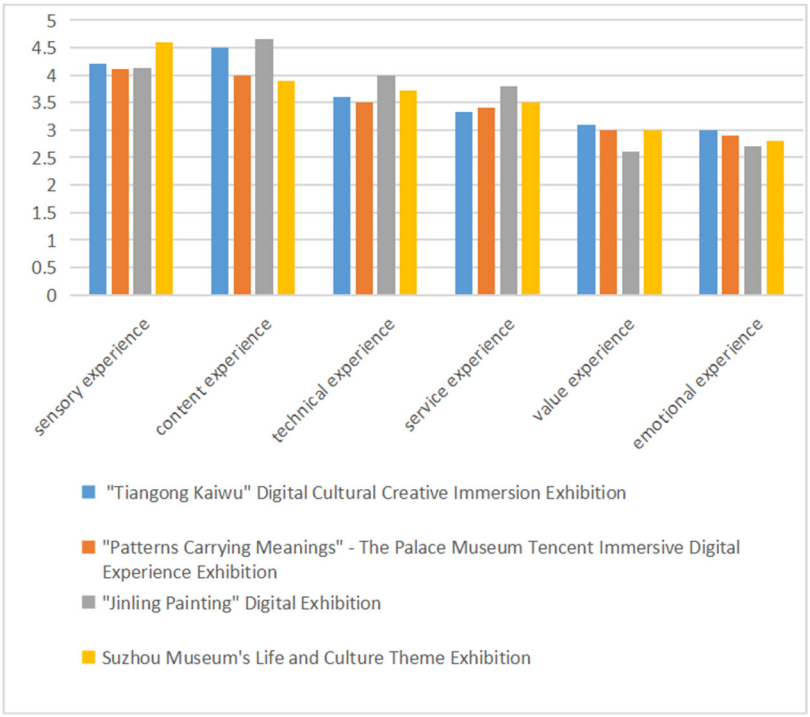

Figure 1. Analysis results of the user comprehensive experience scale for each case in the digital cultural scene

4.3. Discussion of Results

From the above analysis of the results, users have formed a clear sense of experience in digital cultural scenes. Through the previous research and analysis of the comprehensive user experience scale for each case, we have identified the following issues:

4.3.1. Incomplete construction of the digital system and lack of innovative perspectives in sensory technology applications

The foundation of the construction of digital cultural scenes is the development and application of digital technology. After years of digital development in the cultural industry, digital cultural resources and display technologies have been continuously improving, and the system has gradually become more complete. However, there are issues regarding the non-standard collection of cultural data, copyright, and benefit distribution. At the same time, many scene constructions remain within the "comfort zone" of cultural and technological display, and require further strengthening of display, transformation, and innovation.

4.3.2. The cultural content and digital presentation form are single, and the value of content experience is discounted

The novelty brought by digital presentation forms has sometimes led to a situation where the exhibition prioritizes technical effects over high-quality exploration and communication of cultural content. Moreover, the positive rise of content experience value depends on the effectiveness and attractiveness of the content presentation form. In today's

digital cultural scenes, most settings are uniform and the modes are fixed, without innovative and fresh ways of experience that are close to people's daily lives, which directly reduces the user's stickiness and interest in visiting the digital cultural scene. The understanding and popularization of culture require in-depth knowledge of the content, rather than a one-time observation. Context setting needs to actively guide users' cultural cognition.

4.3.3. Lack of diverse communication channels for users to interact with cognitive content, and service awareness needs to be improved

The construction of today's digital cultural scenes usually only focuses on surface presentation, but neglects users' deeper needs. The core service of a cultural scene should be to disseminate cultural knowledge to the public. In addition to conveying basic content, attention should be paid to users' cultural communication needs to meet their potential demands. Users' experience with culture should not be passive, but should lead to cultural awareness through communication and output. At the same time, most digital cultural scenes still have deficiencies in ticketing services, user traffic, information security, and other related services and facilities, which cannot provide users with high-quality service experiences.

4.3.4. Lack of follow-up cultural experience and low emotional connection with users

Currently, the digital cultural scene is mainly built on large-scale interactive devices that stimulate multiple senses, which often provide users with a one-time experience and lack a sense of hierarchy. Although these devices can provide impressive experiences, the content they offer is often relatively simple and cannot meet users' needs for cultural and emotional experiences after a single experience. This greatly reduces the overall value of the cultural scene. Therefore, in the construction of digital cultural scenes, more attention should be paid to the hierarchy and emotional experiences of user experiences to enhance the cultural value and user satisfaction of the scene.

4.3.5. User groups have differences, and different groups have significant differences in their experience of the same scene

In the previous expert discussions, an important issue was raised that the differences in user groups have a significant impact on the experience of the same scene. Taking the immersive exhibition of "Jinling Picture" as an example, the exhibition mainly uses visual and gaming expressions, which may have a positive effect of educating and entertaining young people. However, middle-aged and older users may not get a satisfactory experience due to the lack of effective interactive experiences. In terms of guiding users into the gaming phase, the exhibition lacks a service awareness that considers the needs of different user groups, and needs to provide personalized experience services for different users.

5. Multi-modal Scene Design Strategies

In the analysis of the above cases, it can be concluded that relying solely on rational perspectives for experience elements cannot maximize the differentiation and effectiveness of user experiences in digital cultural scenes. In the subsequent design and construction of digital cultural scenes, it is necessary to actively approach the user experience from a sensory perspective while enhancing the technical experience of content, in order to maximize the penetration of the value of digital cultural scenes and create sustained impact. Based on the above conclusion, the following multimodal digital cultural scene construction strategies are proposed.

5.1. Strengthen the construction of a digital standard system and the research and development of intelligent technology, and build deeply immersive experience scenes

Firstly, it is necessary to improve the construction of the cultural database. The collection, storage, and transformation of digital cultural resources are the key aspects of digital cultural scene construction. Regarding data collection, cultural resources are diverse in type and specific practices involve complex, scattered, and uncertain aspects, requiring more scientific digital classification standards. For deeper cultural content display, deeper exploration is required, emphasizing authenticity during collection. Regarding data format, the current database mainly contains images, videos, and text, with relatively few model-based data, so it is necessary to enhance digital expression and enrich the vertical dimension of cultural resources.

On the other hand, it is necessary to strengthen the research and application of intelligent technology. In interactive display, AI, AR, VR, MR, and other digital technologies are mainly used. While expanding technology research and development, it is necessary to consider innovative applications, such as using AR technology to enable Seattle's traditional fireworks celebration to enter virtual New Year's light shows in thousands of households through the network during the pandemic. Special time points can achieve innovative practices of digital technology, leaving a deep impression, see Figure 2.

At the same time, it is necessary to actively explore the research and development of cutting-edge core technologies such as blockchain, knowledge mining, and digital twins, emphasizing the cross-use and creative transformation of technology in cultural scenes, gradually forming a technical system and application model that can support the wide activation and application of cultural data, and serving the construction of deeply immersive experience scenes.

5.2. Emphasize the appropriate combination of cultural elements and digital infrastructure, and enhance the coherence and interest of the design

In the digital age, relying solely on technological logic is no longer sufficient to meet people's experiential needs. High-quality content experiences are the key to attracting people's attention. As a space with a certain specific cultural value, scenes need to emphasize their thematic and unique features. Therefore, based on a deep understanding of the authenticity, mobility, and cross-cultural significance of local and cross-domain scenes, it is necessary to pay attention to the appropriate combination of different cultural elements and digital infrastructure, as well as the coherence of overall design, in order to ensure users' high-quality content experiences.

At the same time, to maintain the content experience within digital cultural scenes, the attractiveness of situational innovation and presentation is crucial. To this end, game mechanics can be introduced in situational construction to enhance users' emotional experience and sense of agency,

thereby promoting active learning enthusiasm. In addition, in the interactive design of digital cultural scenes, contemporary young people's lifestyles, socialization, and expression methods should be taken into account to create more diverse and colorful experiences. For example, in the Xi'an Daming Palace Museum, users can choose their favorite clothing and makeup through VR technology to show a new image, see Figure 2. In addition, to increase the fun of the tour, Daming Palace also set up an immersive VR virtual Tang Dynasty gift shop, which uses VR store generation and simulation interaction capabilities to restore the experience of shopping around Daming Palace offline, thereby enhancing users' emotional experience and participation within the situational context.These measures help users to obtain more comprehensive, three-dimensional, and multi-sensory experiences in digital cultural scenes, thereby stimulating their enthusiasm and positivity for exhibition viewing.

5.3. Creating Diverse User Interaction Spaces to Enhance the Long-term Function of Cultural Value Communication

The construction of digital cultural scenes involves the relationship between virtual and real, online and offline, and large and small screens. By building digital display and inheritance scenes, creation and transformation scenes, and communication and experience scenes, cultural scenes can be deeply integrated with daily life, education, entertainment, and tourism, reshaping people's understanding of specific cultures, making them feel the cultural charm, and actively participating in cultural inheritance and protection.

To establish a more diverse user experience and connection in the digital cultural scene, user interaction spaces can be set up in the scene, and modern information technologies such as social media, 5G, and cloud computing can be integrated to provide multi-level digital cultural information channels. At the same time, establishing a user community can promote information exchange after viewing, daily push high-quality cultural content, and provide personalized services such as birthday wishes and festival greetings, in order to establish a long-term communication relationship with users. Maintaining community operations and extracting user needs for cultural perception can help upgrade the content and services of digital cultural scenes. Some digital cultural scenes have already provided corresponding services, such as the China National Museum App, which provides a variety of exhibitions and online comments, see Figure 2. Meanwhile, providing more diversified service experiences in ticket services, user traffic, and information security can enhance the long-term function of cultural value communication.

5.4. Launch new cultural consumption products to extend users' cultural emotional experiences

The emotional experience extension of digital cultural scenes needs to be combined with the launch of new cultural consumption products. However, traditional cultural and creative products mostly lack novelty or are just roughly copying cultural elements. In the design of cultural consumption products, attention should be paid to contemporary cultural consumption demands and aesthetic trends, as well as innovation in the direction and form of designing and translating cultural elements.

Under the trend of experience-oriented mass consumption, multi-sensory experiential cultural and creative products, as a more participatory product type, can give users deeper impressions and vivid experiences, provide multi-sensory stimulation to consumers, and thus extend and deepen users' cultural emotional experiences outside of the scene. For example, the Palace Museum cultural and creative products have collaborated with MINISO on joint design. The designed Palace Museum stone drum smart speaker combines the image of the stone drum and deepens users' multi-channel feelings in terms of sight, hearing, and touch, and continues users' recognition and perception of the stone drum image in daily use.

In addition, with the development and application of block-chain technology in recent years, major museums have launched a trend of digital collections, which have been widely loved and supported. Digital collections are based on the creative transformation of traditional culture, which refers to the use of block-chain technology to generate unique digital identities for specific works, artworks, and commodities, and to realize real and trustworthy digital consumption forms based on the protection of their digital copyrights. For example, the series of digital collections launched by the Xi'an City Wall in 2021 have accumulated more than 20 million views, exploring the digital transformation path in the cultural tourism and cultural and creative industries, demonstrating the effective role of digital collections in the creative transformation of culture, and bringing the emotional experience of culture into people's daily lives in a new perspective, see Figure 2.

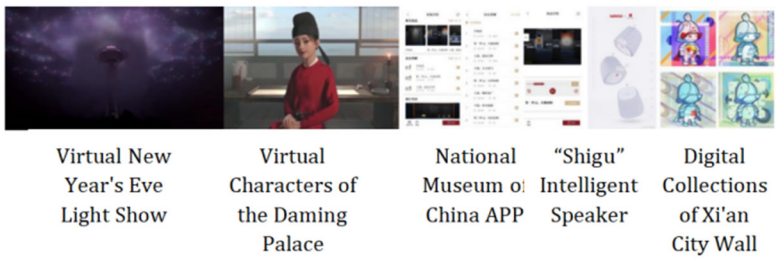

Figure 2. Application examples

6. Conclusion

With the continuous evolution of the digital ecology of the cultural industry, the digital cultural industry, with digitalization as the core engine, is constantly generating strong endogenous power. As a typical path of digital technology empowering the development of the cultural industry, the construction of digital cultural consumption scenes is playing an increasingly important role in enriching the types of cultural product supply, improving the cultural consumption experience, creating more new cultural consumption spaces, fully stimulating and releasing cultural

consumption demand, and has become an important force to promote the development and growth of the cultural industry. This article aims to express, from the perspective of user experience, the inherent nature of providing high-quality content and immersive sensory experiences in cultural scenes, and emphasizes the need to enhance the long-term cultural experience for users by focusing on user value, experience, and emotional dimensions through design methods, extending the scope of the cultural industry value chain.

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