

Research on the Current Application of Digital Technology in Hangzhou Museum

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Abstract:

This paper focuses on the current application of digital technology in Hangzhou Museum, exploring its integration models and practical effects through empirical analysis. The study reveals that the museum has significantly enhanced the dissemination of cultural heritage and audience engagement through virtual interaction, online exhibitions, and integrated reality-virtual displays. However, issues such as insufficient functional depth, limited technical adaptability, and user experience disparities persist. Based on these findings, the research proposes strategies to optimize technology application, emphasizing cultural connotation as the core, balancing innovation with traditional display methods, and improving service accessibility and educational functions. This provides theoretical references and practical pathways for the digital upgrade of museums and the revitalization of cultural heritage.

Keywords:

Museum, Digital Technology, Application Status

1. Introduction

The prosperity of Chinese excellent traditional culture is crucial for national rejuvenation, with the proper preservation and utilization of historical artifacts being indispensable for cultural heritage. As society rapidly develops, traditional museum exhibitions no longer meet public demands. The rise of digital technology has brought transformative opportunities to museums, driving both their evolution and the advancement of digital technologies. This necessitates vigorous promotion of the digitalization of cultural relics, utilizing big data, cloud computing, and artificial intelligence to create smart museums and enable open sharing of cultural relic information. As the primary position for heritage preservation and utilization, museums must deeply understand the logic behind cultural relic revitalization when applying digital technology, continuously exploring innovative and effective approaches to maximize the vitality and charm of cultural relics.

Hangzhou Museum, located in Hangzhou, Zhejiang Province, as a national first-class museum, has been an early adopter of digital artifact display technology. It employs various technologies in themed exhibitions, representing a pioneer in digital

application. This study selects Hangzhou Museum as the research site, conducting surveys among staff and visitors in July 2023 over a month-long period.

2. Types and Scenarios of Digital Displays at Hangzhou Museum

The digital displays at Hangzhou Museum are diverse, categorized based on the user's physical location into three types: on-site, online, and mixed-reality. [1]

2.1. On-site

In physical spaces, audiences engage “on-site” through exhibition halls, displays, and multimedia to access artifact information. Multimedia and digital technologies bridge gaps between offline exhibits and viewers, e.g., holographic projection and interactive touchscreens.

2.1.1. Holographic Projection:

Using digital projection to record and reproduce 3D images of artifacts, often presented in exhibition areas or as decorative elements.

2.1.2. Interactive Touchscreens:

Enable audiences to explore historical events and figures through touch interactions, commonly found in lobbies or exhibition zones.

2.2. Online

In cyberspace, audiences browse virtual exhibitions online via modeling techniques, accessible via computers, smartphones, tablets, or VR devices.

2.2.1. VR Technology

Creates immersive virtual environments for appreciating distant artifacts or histories, typically via headsets or glasses.

2.2.2. 3D Modeling

Constructs digital replicas for virtual museums, restoration demos, etc., allowing global visitors access without physical visits.

2.3. On Mixed-Reality

In hybrid spaces, audiences achieve virtual presence through AR and other technologies, blurring boundaries between physical and digital.

2.3.1. AR Technology

Enhancing real-world perception with virtual info-layers, accessible via apps on smartphones or glasses.

2.3.2. Autostereoscopic 3D

Delivers stereoscopic visuals without special glasses, creating lifelike experiences.

3. Advantages and Disadvantages of Current Digital Technologies at Hangzhou Museum

Digital technology, as a fusion of modern science and traditional culture, has brought revolutionary changes to museum exhibitions, management, and communication. Its advantages are prominent, and it has greatly benefited these areas; however, its drawbacks have also gradually become apparent in the process of use.

3.1. Advantages

3.1.1. Innovative

Combines virtual-real, dynamic-static, and interactive methods, enriching cultural heritage presentation. Compared with traditional exhibitions, digital display technology can create more display opportunities for museums, resulting in more innovative presentation methods for exhibits. The integration of ancient artifacts with modern technology has attracted the attention of specific audience segments, to some extent promoting the dissemination of cultural heritage knowledge. [2]

3.1.2. Interactive

Engages audiences through VR, AR, touchscreens, enhancing experience entertainment. Visitors can gain a deeper understanding of exhibit information through these technologies, such as experiencing history in an immersive way through VR technology, or interacting with exhibits via touch screens, allowing them to appreciate the collections from multiple angles.

3.1.3. Boundary-Breaking

Transcends both time and space limitations via online platforms, enabling globally access.

3.2. Disadvantages

3.2.1. High substitutivity

Many digital tools remain basic interpretive aids, which can substitute by traditional methods. Although digital technology has assisted in the display of cultural relics to some extent, most applications fundamentally prioritize innovation over substance, failing to truly achieve seamless integration with the artifacts. For instance, AR glasses-based interpretations, which can be effectively replaced by conventional electronic audio guides or human-guided tours, may even be less favored than personalized human explanations among the general public.

3.2.2. Low Cultural Integration

The current digital displays tend to rely on a relatively limited range of technical methods, primarily dependent on conventional digital presentation forms such as images and videos, lacking innovation. The exhibition effects are often underwhelming, failing to achieve seamless integration with cultural relics and remaining at a superficial level of human-computer interaction. Moreover, the majority of museums employ digital technology merely for the sake of “utilizing” it, treating it as a promotional gimmick rather than prioritizing the dissemination of

cultural heritage knowledge, thereby deviating from the fundamental purpose of applying digital technology.

3.2.3. Costly Development/Maintenance

The development and subsequent maintenance costs of digital technology are relatively high. For instance, in the field of cultural heritage exhibition, digital technology requires extensive technical support, including computer science and artificial intelligence. The research, development, and implementation of these technologies demand significant financial investment, especially considering the continuous evolution and upgrading of technology, making substantial expenditures inevitable. Furthermore, to ensure the lasting appeal of digital displays, it is necessary to constantly refresh the exhibit content, which involves sustained investments of human, material, and financial resources.

3.2.4. Overuse

Many digital display technologies overly pursue novelty and peculiarity while misinterpreting the “immersive experience” and “interactivity” brought by digital media. They mistakenly believe that simply incorporating sound, light, and electrical effects into exhibitions constitutes true immersive display. Such practices diminish and overshadow the cultural and artistic appeal of the artifacts themselves. The excessive use of digital technology causes the cultural essence of the collections to be overshadowed by superficial presentations, ultimately leading museums and cultural relics to lose their authentic essence.

3.2.5. Lack of Personalization

Standardized content neglects diverse audience interests.

4. Field Research Summary and Analysis at Hangzhou Museum

4.1. Diverse Digital Technologies

With the advancement of technology, various digital display technologies have emerged, and the increasing spiritual and cultural demands of the people have become more prominent. As the number of museum visitors grows, the Hangzhou Museum has introduced multiple digital display technologies. In terms of artifact interpretation, in addition to the commonly known audio guides, the Hangzhou Museum has added a paid rental service for AR glasses. Visitors can wear AR glasses, scan the artifacts to obtain knowledge about them, and also use voice commands to control the AR glasses for interpretation. Furthermore, the museum has implemented multimedia touchscreen interaction technology. Visitors can use the multimedia screens placed in the corridors, on the walls, and beside the artifacts to independently tap and view pre-stored introductions and interpretations of the museum and its collections. In the aspect of artifact display, the museum utilizes 3D projection technology to project the artifacts within the exhibition area, showcasing the details of the artifacts in a comprehensive manner and providing the audience with a brand-new visual experience.

4.2. Functional Limitations

The mentioned AR glasses-based interpretation devices, multimedia screen interactions, and 3D projection technologies fundamentally serve only the functions of knowledge explanation and artifact display. However, the dissemination of artifact

knowledge was already achievable during the era of human-guided tours and the application of simple audio guides. AR glasses-based interpretation merely enriches the form of knowledge delivery, but lacks the adaptability and initiative characteristic of human-guided interpretation due to its reliance on pre-stored data within the device. Compared to conventional audio guides, AR glasses incur higher rental fees owing to their elevated development and operational costs. At their core, whether AR glasses-based interpretation or multimedia screens, both store existing knowledge in digital formats and present it through multimedia audio-visual effects. This approach fails to empower audiences to independently explore deeper content or satisfy personalized needs. In essence, digital technology here merely fulfills a basic information transmission role, without leveraging its unique and irreplaceable potential in artifact exhibition and cultural transmission.

4.3. High threshold

Through observation and interviews, it has been found that digital technologies in museums still face issues related to high usage barriers.

First, there is a high financial threshold for using digital technologies. For artifact interpretation, the Hangzhou Museum offers three forms of guidance: scheduled, session-based human-led tours; audio guides; and AR glasses-based interpretation. While free human-guided tours are in high demand, limited staffing restricts these tours to fixed schedules and strict capacity limits per session, requiring advance reservations. Audio guides can be rented independently for 20 yuan, whereas AR glasses rentals cost 50 yuan plus a 200 yuan security deposit. Compared to the first two options, the rental fees for AR glasses are significantly higher, deterring a large portion of visitors—especially those with limited financial means—from accessing this technology.

Second, digital technologies pose operational challenges for users. After renting AR glasses, visitors must watch a several-minute tutorial video or rely on staff assistance to operate the devices, creating high barriers for children, elderly visitors, and other groups. Even after learning basic functions, some visitors encounter difficulties during their tour and repeatedly return to the rental desk for help, disrupting their experience and occasionally leading to conflicts with staff. While multimedia screens are less technically demanding than AR glasses, they still present significant challenges for elderly visitors, individuals with low literacy levels, or those without formal education.

5. Improvement Measures

The Hangzhou Museum has a high degree of popularization in digital display, but there is still much room for improvement. In order to better integrate digital display technology with cultural relics and bring cultural relics to life, the digital display of museums should have the following characteristics:

5.1. Personalized Experiences

Firstly, when promoting personalized digital exhibitions, museums need to deeply understand the needs and interests of their audience. This can be achieved through data analysis [3], online interactions, and other methods to collect information and feedback from visitors. By analyzing their age, gender, cultural background, hobbies, and other characteristics, museums can identify the points of interest different groups

have in museums and their collections. This enables the provision of personalized exhibition content and services tailored to various audience groups.

Secondly, museums should customize personalized content. For example, they can design exhibition themes and digital formats that align with the cultural cognitive levels and interests of visitors of different age groups; offer targeted commentary and exhibition content for audiences from diverse cultural backgrounds; and provide barrier-free or interactive digital display methods for visitors with special needs, such as persons with disabilities or children.

5.2. Enhanced Cultural Alignment

To enhance the integration of digital displays with cultural relics, museums need to conduct in-depth research on the historical background, craftsmanship, and cultural connotations of each artifact. This provides abundant materials and a solid foundation for digital exhibitions, which is fundamental and a top priority for museums utilizing digital technologies. Secondly, museums should select appropriate digital display methods based on the characteristics and exhibition needs of the artifacts. For example, three-dimensional (3D) reconstruction and printing techniques can be employed for large or intricately detailed relics; virtual reality (VR) or augmented reality (AR) technologies can recreate historical contexts, truly "breathing life" into the cultural heritage.

5.3. Balanced Tech Integration

When designing digital exhibitions, museums must exercise caution against excessive reliance on digital technologies to avoid overshadowing the core attraction. It is crucial to remember that digital display techniques serve merely as auxiliary tools, not the protagonist. The artifact itself must always remain the focal point of the audience's attention.

In planning digital exhibitions, curators should carefully consider the unique characteristics and historical context of each artifact to ensure digital technologies complement rather than conflict with the cultural relics. Overly gimmicky display technologies should be avoided, as they risk diverting viewers' focus. Within exhibition areas, preserving traditional presentation methods—such as physical displays and textual descriptions—remains essential. A harmonious blend of traditional and modern approaches enables audiences to better comprehend and appreciate the cultural significance of the artifacts.

5.4. Diversified Content

The diversification of digital technology displays can be categorized into content and form. Regarding content, museums can design digital displays with different themes based on the characteristics of their collections and exhibition themes, covering various fields such as history, culture, and art, to cater to the interests and needs of diverse audiences. It is essential to ensure the diversity of digital display content. For example, the content on digital interactive screens should not remain static but be regularly updated, and the interaction methods should not be monotonous. Museums need to seek innovation in existing digital displays, which can be achieved through interdisciplinary collaboration. By cooperating with other institutions or organizations to jointly plan and produce digital exhibitions, such collaborations can bring fresh perspectives and creativity, further enriching the display content.

In terms of form, digital displays should integrate multiple digital technologies to create engaging exhibition content. This includes designing various interactive segments, such as touchscreen interactions, virtual reality (VR) experiences, and even gamified formats that allow visitors to participate directly in the exhibition and interact with cultural relics. These approaches enhance audience engagement and the overall experiential quality of the exhibition.

5.5. Educational Roles

Museums should leverage digital technology to fulfill their educational responsibilities. Digital exhibitions can be designed with various interactive elements, such as online quizzes, virtual tours, and interactive games, to encourage active participation and enhance the initiative and enjoyment of learning.

Through interaction, visitors can gain a deeper understanding of the exhibit content, strengthen memory retention, and improve critical thinking skills. By targeting youth communities and the general public, museums can organize public interest educational programs—both online and offline—such as lectures and artifact-based workshops. Through these initiatives, museums can disseminate knowledge, preserve cultural heritage, and contribute significantly to educational outreach.

5.6. A Fully-featured Online Exhibition Hall

To create a comprehensive online exhibition hall, museums need to prepare digital collections. This requires utilizing high-resolution photography equipment, 3D reconstruction, and 3D scanning technologies to conduct all-around digital collection of the museum's artifacts. This includes capturing the appearance, details, and historical background of the artifacts. Subsequently, the digitized artifacts are restored as realistic virtual models, providing visitors with an immersive viewing experience.

Moreover, a perfect online exhibition hall also necessitates the design and development of a reliable, maintainable, and scalable database system to ensure effective organization and management of digital resources. In this way, more people can appreciate the museum's precious collections online. Meanwhile, through digital technology, the museum's visibility and influence are enhanced.

6. Conclusions

Museums serve as a vital carrier for modern public cultural undertakings and play a crucial role in enriching people's spiritual and cultural lives. The continuous development of digital technology has provided innovative perspectives and concepts for modern museum exhibitions. Relying on digital technology, museum administrators should apply it scientifically and rationally to effectively promote the dissemination of cultural heritage knowledge, better meet the needs of visitors, and create diverse, personalized, and immersive visiting experiences. This approach offers visitors a renewed spiritual and cultural feast, thereby advancing the widespread dissemination of cultural heritage knowledge throughout society and raising public awareness and commitment to its preservation.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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