

Preservation Preferences for Cultural Relics in Traditional Chinese Museums: Balancing Tradition and Technology

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ABSTRACT

Traditional Chinese museums face the dual challenge of preserving fragile cultural relics and engaging modern audiences. Current preservation methods often emphasize either physical conservation or digital representation; however, an integrated approach may be more effective. This study examined the state of cultural relic preservation in Chinese museums, highlighted key limitations of current practices, and explored the potential of integrating Mixed Reality (MR) and Human-Exhibition Interaction (HEI) to enhance preservation outcomes. By focusing on both artifact safety and visitor engagement, this research identified optimal preservation strategies for sustaining cultural heritage in China. Additionally, this paper proposed a conceptualization that leverages advanced technologies and interactive methods to address contemporary challenges while respecting traditional conservation philosophies.

Keywords: *Cultural relic preservation, Human-Exhibition Interaction, Mixed Reality, Traditional Chinese museums, Sustainability*

INTRODUCTION

Cultural relics are the physical embodiments of the history, culture, and identity of a nation, serving as crucial links between the past and present. In China, museums are central to preserving invaluable artifacts, showcasing the country's long and complex heritage to both domestic and international audiences. As institutions responsible for safeguarding historical narratives, museums face a delicate balancing act: preserving relics' physical integrity while making them accessible and engaging to the public.

Challenges in Preservation

The preservation of cultural relics in Chinese museums faces two significant challenges. Firstly, natural decay and improper restoration practices pose ongoing threats to cultural relics. For example, traditional methods often involve physical intervention that provides temporary preservation, but it can cause irreversible damage over time (Sun, 2019; Zhao et al., 2018). Most museums rely on static exhibitions that limit visitor engagement, as relics are often enclosed in glass cases with minimal interactivity, reducing their appeal to modern audiences accustomed to dynamic, technology-driven experiences (Lischke, 2014).

Research Objectives

The growing gap between the needs of artifact preservation and public engagement calls for innovative approaches that integrate advanced technologies with traditional preservation practices. To address these challenges, this study explored how advanced technologies like Mixed Reality (MR) and design principles like Human-Exhibition Interaction (HEI) can revolutionize cultural relic preservation and presentation in Chinese museums. Specifically, the research aims to:

1. Analyze the current state of cultural relic preservation methods in Chinese museums.
2. Explore the potential of MR and HEI to address preservation and engagement challenges.
3. Propose a conceptualization for integrating these approaches to create a more sustainable and engaging museum experience.

LITERATURE REVIEW

This research aims to uncover Chinese museums' preferences in protecting cultural relics. It uses a systematic literature review to find studies on digital tech in museums. The study outlines museum preservation strategies and reviews tech applications in heritage and sustainable interaction.

Current Preservation Practices in Chinese Museums

Cultural relic preservation in Chinese museums has traditionally focused on physical conservation, emphasizing the use of controlled environments, material restoration, and preventive measures. Measures such as maintaining stable temperature and humidity levels and avoiding direct light exposure have become standard (Yike et al., 2020). Furthermore, the philosophy of "restoring the old as the old" underscores the importance of maintaining historical authenticity during restoration processes (Lu, 2012).

However, while traditional practices effectively safeguard artifacts, they often come at the cost of accessibility. Most museums choose to store fragile relics away from public view or display them in ways that minimize interaction. This restriction limits opportunities for education and public engagement, particularly among younger generations who are more attuned to interactive and multimedia experiences (Lischke, 2014). Despite the necessary physical interventions for restoration, it can inadvertently damage artifacts, especially those made of organic materials such as wood or textiles (Sun, 2019). While these practices safeguard relics, they only contribute little to enhancing the museum experience for visitors.

Digital technologies have introduced new possibilities for cultural relic preservation. In recent years, Chinese museums have begun adopting digital technologies to enhance preservation and exhibition efforts. These include 3D Imaging and Photogrammetry that enable the creation of highly detailed digital replicas and this technology is applicable for research, education, and virtual exhibitions. Studies have shown that such methods enhance both preservation and accessibility (Feng, 2017; Zhao et al., 2023). Other technologies, like Non-Destructive Analysis technologies exemplified by X-ray CT and MRI, provide non-destructive methods for studying relics, revealing hidden details and internal structures (Vanhoof et al., 2021; Wagner et al., 2023). Virtual Museums Platforms such as the Mogao Caves Digital Reconstruction have made fragile cultural heritage accessible to a global audience through immersive virtual experiences (Fu et al., 2020).

Most museums continue to rely on traditional displays, causing them to miss the opportunities to fully leverage digital tools for visitor engagement. Despite these advancements, the application of digital technologies in Chinese museums often remains fragmented, with limited integration into regular exhibition practices (Lu, 2022; Xu, 2023).

The Case for Mixed Reality and HEI

Mixed Reality (MR) technologies, encompassing Augmented Reality (AR) and Virtual Reality (VR), offer transformative potential for museum exhibitions. By overlaying digital information onto physical spaces, MR can create immersive experiences that bring cultural relics to life. For example, visitors could use AR devices to see how an ancient vase was crafted or used in its original context. Creating VR experiences where users can virtually explore ancient sites reconstructed from archaeological data, such as the immersive walkthroughs of Dunhuang's Mogao Caves (Fu et al., 2020).

HEI focuses on designing exhibits that actively involve visitors. Through interactive storytelling, sensory engagement, and user-centered design, HEI creates deeper connections between audiences and artifacts. For instance, interactive touchscreens can provide layered narratives, allowing visitors to explore the history, craftsmanship, and cultural significance of a relic. Studies showed that empathetic curation—considering the visitor's perspective—enhances both satisfaction and learning outcomes (Bitgood, 2006; Serravalle et al., 2019). In the Chinese museum context, integrating HEI with MR could bridge the gap between traditional preservation methods and modern expectations for interactivity. This study suggests that combining MR and HEI can address key limitations in current preservation practices. By creating digital replicas for interaction while safeguarding physical artifacts, museums can achieve a balance between preservation and accessibility. The combination of MR and HEI can create digital replicas for interaction, and museums can protect fragile relics while offering dynamic and immersive experiences and address the shortcomings of traditional displays, creating informative and emotionally engaging exhibitions.

FINDINGS

Chinese museums can adopt hybrid exhibition models that combine traditional preservation practices with digital enhancements. For example, projection mapping (Sun, 2019) and MR-enhanced galleries (Dang et al., 2023). These techniques have the capability to enliven static displays by animating them, vividly demonstrating how artifacts were utilized in their original contexts. Through integrating Augmented Reality (AR) and Virtual Reality (VR) technologies, museums can elevate the visitor experience, creating dynamic interactive environments that allow guests to immerse themselves in a journey where they can virtually "walk through history." Chinese museums must balance their responsibility to preserve artifacts with the need to engage audiences. This study identifies three key preferences for achieving this balance. Digital documentation should become a standard practice in Chinese museums. By creating detailed 3D scans and digital twins, museums can preserve the physical and visual attributes of artifacts for future generations. These digital assets also provide valuable resources for virtual exhibitions and educational programs (Dang et al., 2023). Museums should integrate digital technologies into physical displays. For example, projection mapping can animate static exhibits, while MR applications can provide context and depth.

Exhibitions should prioritize the visitor experience, using HEI principles to create engaging and accessible displays. For example, touchscreens allow users to explore different layers of an artifact's history. These digital assets in interactive displays help visitors to explore relics virtually without risking physical damage. Incorporating MR technologies to enhance storytelling could provide contextual depth for exhibits. One successful example of integrating technology and preservation is the digital reconstruction of the Mogao Caves in Dunhuang (Fu et al., 2020). The Mogao Caves project demonstrates the effectiveness of digital tools in preserving and presenting cultural heritage. High-resolution imaging protects the fragile cave paintings and allows researchers to study their intricate details without causing damage. Visitors can now explore the caves virtually, experiencing the artwork in its historical context. This project demonstrates how digital tools can protect cultural heritage without compromising visitor engagement.

Design exhibits that encourage interaction, such as touchscreens, AR apps, or guided experiences with virtual narrators, could make museums more engaging and educational for a wider audience. The study foresaw that retaining core principles of Chinese preservation philosophy and adopting complementary digital tools could ensure the authenticity of relic preservation without sacrificing accessibility. For example, integrating AI-driven storytelling into exhibits could personalize visitor experiences, while advanced sensors could monitor artifact conditions in real-time, enabling proactive conservation.

CONCLUSION

Chinese museums are custodians of the world's most precious cultural relics. A critical juncture is needed to reconcile the vestige-preserving method and serve contemporary demand to engage modern audiences meaningfully. This study underscores the significant potential of incorporating Mixed Reality (MR) technologies and the principles of Human-Exhibition Interaction (HEI) into the conventional methods of preservation. Integrating MR and HEI in museums could safeguard their invaluable collections through meticulous digital documentation by ensuring each artifact is preserved for future generations. Visitors could transform the visiting experience into valuable immersive and interactive activities, therefore making cultural heritage more accessible and engaging. This integration aligns Chinese museums with global trends in the field of cultural heritage conservation, allowing them to maintain their relevance in the 21st century. The study concludes that the future of cultural relic

preservation in Chinese museums hinges on a balanced approach that leverages the time-tested merits of traditional preservation strategies by fully embracing the innovative possibilities offered by digital technology. This potential synergistic approach will protect and preserve cultural relics and inspire a new generation to form a profound connection and appreciation for their cultural heritage, ensuring that these treasures continue to be valued and sustained for generations to come.

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