

Research on the Design of Digital Display of Ancient Books and Cultural Relics in the National Museum of Classics

Yuhan Zhang

*East China University of Science and Technology, Shanghai, China
15345462183@163.com*

Abstract. Virtual reality technology not only enables the digital reconstruction and immersive presentation of cultural relics, enhancing the public's cultural experience, but also offers innovative solutions for cultural heritage preservation. Its applications in the preservation and exhibition of cultural relics have become increasingly prominent. This paper aims to explore innovative approaches to the digital display and interactive experience design of ancient books and artifacts at the National Museum of Classic Books. Two famous exhibitions of the National Library Museum were selected - 'Entering the True by Observing the Marvelous: Highlights of Cultural Relics from the Yongle Palace in Shanxi and a Digital Art Exhibition' and 'Memories of Oracle Bone Inscriptions'. Using these as examples of the technology and presentation methods for the digital display at the National Library Museum, suggestions for its future digital exhibition were proposed based on the layout of the museum and its existing collections, combined with today's advanced virtual reality and AI technologies. Through case analysis, user research, technological application analysis, and interdisciplinary theoretical integration, the study proposes new methods for digital display design and optimized strategies for interactive experiences involving ancient book relics.

Keywords: Virtual Reality Technology, Immersive Interactive Experience, Museum Digitalization

1. Introduction

Driven by the global wave of digitalization, the protection and dissemination of cultural heritage are facing unprecedented opportunities. Active support from national policies has laid a solid foundation for the digital transformation of cultural heritage, prompting various cultural institutions to accelerate the adoption of advanced technologies for preservation and exhibition. In particular, the rapid development of technologies such as virtual reality (VR), augmented reality (AR), 3D modeling, and artificial intelligence (AI) has not only revolutionized the way exhibitions are presented in museums and similar institutions but also significantly enhanced audience engagement and experience. Therefore, guided by national policies and fueled by technological innovation, the research into the digital preservation and dissemination of cultural heritage provides crucial theoretical and practical support for broader cultural sharing and transmission.

By examining the application and analysis of digital display and interactive experience design, as well as exploring new approaches to digital display design, this paper aims to offer systematic guidance for the digital presentation of cultural heritage, thereby enhancing its communicative impact and public engagement.

2. Digital display at the National Museum of Classic Books

2.1. Overview and analysis of the National Museum of Classic Books

Affiliated with the National Library of China, the National Museum of Classic Books was set up to broaden public access to China's classical textual heritage. It is not simply a vault for rare holdings; it extends the Library's public mission through education and cultural outreach. In practice, the museum plays several complementary roles: it acquires and preserves traditional literature; curates both long-term and themed exhibitions; supports research on classical texts; and runs lectures, guided tours, and other programs that introduce these works to diverse audiences. The museum also serves as a venue for international engagement with classical culture, bringing scholars and visitors from abroad into direct contact with Chinese sources in a dedicated setting. Looking ahead, it is poised to further knit together museum- and library-based services—especially for younger visitors—and to consolidate its position as a key platform for learning about and transmitting traditional Chinese culture.

2.2. Overview of digital exhibitions at the National Museum of Classic Books

On January 12, 2025, the exhibition *Entering the Sublime: Cultural Relics from Yongle Palace, Shanxi – A Digital Art Exhibition* (Figure 1) will officially open to the public in Exhibition Halls 3 and 4 of the National Museum of Classic Books. The exhibition unfolds through four thematic sections: *A Grand Panorama*, *Harmony in the Mundane*, *A Universe on the Wall*, and *Mountains and Rivers Everlasting*. It features an immersive virtual reality theater titled *Magical Tour of Yongle*, which combines valuable artifacts with cutting-edge digital technologies, allowing visitors to experience the artistic beauty and spiritual essence of Yongle Palace in an immersive setting.



Figure 1. *Entering the Sublime: Cultural Relics from Yongle Palace, Shanxi – A digital art exhibition*

On April 5, 2023, the exhibition *Memory of Oracle Bone Script* (Figure 2) opened to the public in Exhibition Hall 5 of the National Museum of Classic Books. Organized into four thematic sections—“*Reemergence of Civilization*,” “*Mysterious Characters*,” “*A Miraculous Kingdom*,” and “*The Journey of Exploration*”—it brings together oracle bones, archaeological photographs, and research materials that document the discovery, decipherment, and ongoing study of oracle bone inscriptions. By connecting individual artifacts with broader narratives of early Chinese writing and ritual practice, the exhibition outlines key stages in the formation of Chinese civilization and demonstrates why oracle bone inscriptions are regarded as both the earliest known form of Chinese characters and a crucial source for understanding China's classical heritage. In this way, the exhibition invites visitors to reflect on the depth of China's historical experience and to relate contemporary discussions of cultural inheritance to a longer civilizational trajectory.



Figure 2. Memory of Oracle Bone Script exhibition

3. Application and analysis of interactive experience design for ancient book artifacts

3.1. Application of virtual reality technology

In the Yongle Palace exhibition, designers created immersive digital environments to enhance audience engagement. For example, the walk-through panoramic dome theater vividly recreates the grand scene depicted in the mural *Paying Homage to the Primordial Deity* from the Hall of Three Purities (Figure 3). The digitally animated *Divine Manifestation Journey of Lord Chunyang* (Figure 4) transports visitors into a vividly rendered green-and-blue landscape painting, where they can "roam the world" alongside the immortal Lü Dongbin, immersed in an atmosphere where technology and art seamlessly converge. This kind of immersive experience not only deepens visitors' understanding and appreciation of cultural heritage but also introduces innovative exhibition formats to the museum setting.



Figure 3. Panoramic dome theater recreating the grand scene of the mural "Paying Homage to the Primordial Deity" from the Hall of Three Purities



Figure 4. Digitally animated "Divine Manifestation Journey of Lord Chunyang"

By incorporating large-scale VR space technology, visitors wearing VR headsets can virtually enter the paintings and traverse through walls, embarking on a mystical journey in Yongle Palace beginning with the mural story "Meeting the Immortal on the Bridge, Releasing Life on Mount Lu" in Chunyang Hall. During the experience, visitors can soar above Yongle Palace, interact with mythological creatures on its rooftops (Figure 5), and freely explore the exquisitely decorated interiors of the Hall of Three Purities, appreciating the architectural beauty up close. Of particular note, visitors can also become digital painters, collaborating with Zhu Haogu, the legendary leader of

the Jin-South School of mural art, in the creation of Yongle Palace murals. This shared journey offers a vivid and perceptible dreamlike artistic adventure. The immersive experience thus enhances cultural comprehension and introduces new possibilities for museum exhibition design.



Figure 5. AI-enhanced visualization of deities in the Hall of Three Purities

3.2. Multimedia interactive experience design

Interactive design has become central to recent museum practice, especially through the use of large-scale artistic installations. For example, augmented reality (AR) enables visitors to obtain additional textual and visual information about specific objects on their smartphones, extending the experience beyond the static display. In the Memory of Oracle Bone Script exhibition, the National Museum of Classic Books uses sound to evoke the atmosphere of ancient ritual performances: when visitors press buttons associated with instruments such as the xun (ocarina), drum, and chime stone, carefully recorded sounds of each instrument are played back, encouraging them to imagine how these objects might once have been used and heard.

Beyond the sound design, the museum coordinates lighting with light tactile cues to “wake up” the virtual layer and tether it to the physical exhibits. A popular stop is the oracle-bone divination simulation (Figure 6). Here, a life-size turtle plastron replica bears engraved Shang-dynasty records—queries about weather, warfare, travel, harvest, and hunting. After the visitor picks one theme, a large oracle-bone model stages the procedure: first a hole is drilled into the back of the plastron; glowing charcoal is then applied; cracks spread across the front. The system highlights how diviners read intersecting lines and angles to judge auspicious or inauspicious outcomes. Gesture-based interaction—driven by motion-capture—lets visitors mimic a diviner’s actions, while synchronized sound and lighting sketch the ritual setting of Shang-era practice.



Figure 6. Shang Dynasty oracle bone divination simulation device at the National Museum of Classic Books

The display for the Heavenly Stems and Earthly Branches extends the same design logic. Ten upright columns in a circle (Figure 7) stand in for the Ten Heavenly Stems, and projected patterns

render the Twelve Earthly Branches. The spatial arrangement, coupled with layered audio-visual effects, invites visitors to move through the ring of columns and to experience the calendrical system as something embodied rather than purely abstract (Figure 8). Other installations—including the “Three-Dimensional Scroll,” the “Surname Grove,” interactive oracle-bone calligraphy, the Yongle Palace digital mural screen, and a suite of multimedia games—are built for repeated trials and playful tinkering. Taken together, these systems encourage exploratory engagement and help visitors form a more concrete grasp of the cultural and historical contexts behind the artifacts on display.



Figure 7. Heavenly Stems and Earthly Branches model matrix

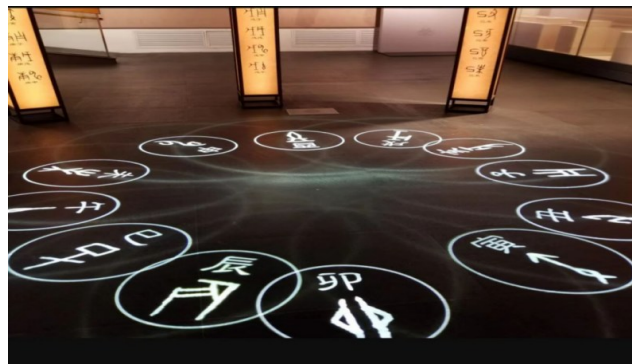


Figure 8. Demonstration animation of the Heavenly Stems and Earthly Branches model

3.3. AI-assisted innovations

The rapid development of artificial intelligence (AI) technology has brought new possibilities to the display and interactive experience of cultural heritage. Through AI “activation” (Figure 9), artworks are revitalized, not only enhancing visitor interaction but also diversifying exhibition formats. For example, in the Yongle Palace special exhibition at the National Museum of Classic Books, AI was employed to animate the deities in the Hall of Three Purities, reviving legendary murals and immersing visitors in a vivid historical narrative. This greatly enhances the exhibition’s appeal and educational value.



Figure 9. AI image processing used to “revitalize” artwork

4. Exploring new approaches to digital exhibition design

4.1. Digitization and restoration of cultural relics

Digital acquisition is the first step in protecting cultural relics. Using high-precision scanners and photographic equipment, every detail of an artifact is recorded to provide essential data for subsequent 3D modeling and virtual restoration. 3D reconstruction technology does more than simply replicate the appearance of an artifact—it can reconstruct damaged or lost cultural heritage to restore its original form.

When physical reassembly would risk further damage, virtual restoration reconstructs fragmented artifacts as three-dimensional models suitable for display. In the case of the well-known Dream of the Red Chamber woodblock prints held by the National Museum of Classic Books (Figures 10–11), technicians employ 3D laser scanning to acquire a dense point cloud for each block’s surface. The dataset captures both the carved imagery and the minute traces of wear and loss. After reconstruction, the prints are delivered in an interactive viewer that supports rotation, zoom, and close inspection of details that are difficult to perceive in a conventional display case [1]. For specialists, such models support side-by-side comparison and quantitative analysis; for general visitors, they offer a straightforward way to explore the craft and visual richness of traditional woodblock printing.

Digital acquisition, therefore, feeds directly into long-term preservation and interpretation. High-resolution records fix an object’s condition at a given moment, creating a reference archive for future conservation work and for re-curating exhibitions as new questions arise. The same datasets can also be repurposed to build virtual or mixed-reality environments in which reconstructed artifacts are situated within simulated historical settings rather than shown as isolated pieces. In turn, audiences can sense how such works might originally have been viewed, handled, and circulated, and can relate contemporary digital presentations to the historical lives of the artifacts.



Figure 10. Exhibition area of the Dream of the Red Chamber woodblock edition at the National Museum of Classic Books



Figure 11. Image of the Dream of the Red Chamber woodblock edition

4.2. Immersive and interactive experience design

In digital exhibition design, immersion and interactivity are central not only to attracting attention but also to shaping how visitors interpret cultural materials. Recent technologies make it possible to approximate sensory experiences through algorithm-driven visual and auditory effects, while sensor systems record body movement, gesture, and touch. Exhibitions therefore move beyond one-way information transmission: visitors are invited to experiment with different modes of engagement and to leave visible traces of their own participation.

The adoption of naked-eye 3D techniques has changed how ancient books and artifacts are presented. By constructing enclosed projection spaces and enabling virtual roaming, designers can place textual and visual content above, below, and around the viewer, turning the reading of classics into a spatial experience. In the Traditional Chinese Classics Exhibition Area of the National Museum of Classic Books, works such as *The Classic of Mountains and Seas*, *Zizhi Tongjian*, and *Book of Han* are reinterpreted in an immersive naked-eye 3D environment. Animations based on episodes and motifs from these texts unfold in sequence, suggesting shifts in time and perspective. An intelligent touchpoint system allows viewers to trigger specific scenes rather than passively watching a looped animation. For example, in the *Classic of Mountains and Seas* section, touching the image of a mythical beast sets off different responses—such as flight, turning toward the visitor, or changing expression—thereby linking iconic creatures in the text to concrete interactive behaviors (Figure 12).



Figure 12. Image of the Classic of Mountains and Seas woodblock edition

When constructing a virtual ancient book library, designers can further increase interactivity by supporting multi-user, collaborative exploration. One possible configuration places a VR experience zone near the *Dream of the Red Chamber* print exhibition area and reconstructs the Grand View Garden as a navigable virtual environment. Wearing VR headsets, visitors can walk through courtyards and pavilions, join in activities such as poetry recitation, tea tasting, and appreciation of

flowers, and encounter virtual figures including Jia Baoyu and Lin Daiyu. These encounters are not only visual but also structured as small tasks: for instance, locating particular objects associated with key chapters or unlocking additional dialogue by completing narrative missions. Such task-based design encourages visitors to negotiate the space together, to share discoveries, and to reflect on how literary settings are translated into interactive scenes, thereby deepening engagement with the cultural themes represented in the exhibition [2].

4.3. Application of digital technology in cultural and creative products

With technological advancement, the application of VR and digital technology in cultural and creative products has become increasingly widespread. Through holographic technology, the static elements of Dunhuang culture can be animated, enhancing interaction between people and products and fundamentally transforming the one-way communication model of traditional culture [3]. For instance, using the Yongle Palace murals as an example, AR technology has breathed new life into traditional flat postcards. When users scan a postcard with a smartphone or other device, the originally static mural transforms into a three-dimensional scene or animation. This innovative display not only attracts more visitors to purchase these postcards as souvenirs but also helps more people appreciate the cultural value embodied in the murals.

In addition, developing digital content—such as turning cultural heritage or traditional stories into games or animations—further promotes cultural inheritance and development. As early as 2019, the National Museum of Classic Books launched the "Shanghai Society" project. With immersive experiences like Ancient Book Defense Bureau, Shanghai Society's Treasure: The Wild Goose Walker, and Restorer of Ancient Paintings, the museum has established a strong immersive exhibition brand in the public consciousness [4]. The core of these storylines often centers on the preservation and restoration of ancient books. As related stories continue to be created, the development of corresponding IP characters can form a distinctive cultural and creative brand. This not only preserves and promotes traditional culture but also expands the cultural and creative industry chain through spin-off products such as toys and stationery.

4.4. AI-assisted digital exhibition

Artificial intelligence is reshaping digital exhibition and conservation in practical, workmanlike ways. In image-based restoration, recognition models help conservators locate and characterize damage, streamlining portions of the workflow without displacing expert judgment. Ancient books and calligraphic or pictorial works often suffer paper deterioration, discoloration, and pigment loss. Trained on high-resolution comparanda, AI image-recognition tools can suggest candidate reconstructions for missing or discolored passages by inferring patterns from surrounding visual cues [5]. These outputs function as reference options to be tested, adjusted, or set aside by conservators during decision making.

AI-supported guide systems constitute a second line of application, particularly when paired with SLAM (Simultaneous Localization and Mapping) for indoor positioning. In galleries and reading rooms, such systems can assemble suggested routes from a visitor's stated interests, available time, and accessibility needs, while overlaying simple navigational hints—arrows, highlighted zones—on phones or fixed displays. Speech synthesis adds object labels, contextual remarks, and alternative commentary tracks, enabling users to select a preferred level of detail or language. Rather than remaining stand-alone apps, intelligent guide services can evolve into shared infrastructure across the GLAM sector (galleries, libraries, archives, and museums). As a national institution, the National Museum of Classic Books is well placed to help design an interoperable smart-guidance framework

linking its online exhibitions and on-site services with those of peer libraries, thereby supporting data exchange and coordinated development [6].

A related direction is the use of AI-generated digital humans as guides and mediators. The National Museum of Classic Books could develop a virtual docent with a recognizable visual identity and a curated knowledge base. Through speech recognition and dialogue management, the docent might field questions on editions, textual content, institutional history, and current programs, while adapting its tone for school groups or subject specialists. Beyond the building, the same persona can appear in short videos or live-streams on social platforms, extending book-centered exhibitions to audiences unable to visit in person.

Finally, AI-based question-and-answer kiosks positioned near rare-book cases can complement labels and catalog entries. Visitors speak or type a query; the kiosk uses natural-language processing to interpret intent, retrieve information from a vetted knowledge base, and produce a concise reply. Where a precise answer is unavailable, the system can point to related objects, catalog records, or recommended reading. When integrated carefully into the exhibition and accompanied by clear indications of source and scope, such kiosks add an interpretive layer and help visitors pursue their own lines of inquiry while engaging with the physical artifacts.

4.5. Intelligent development in the future

Touchless human–computer interaction relies on depth sensors, cameras, and gesture-recognition algorithms that follow hand motion in mid-air. When spatial and temporal resolution are high enough, users can perform basic manipulations—rotating or enlarging an object—without a controller or wearables. In exhibition settings, this approach lets visitors handle holographic models of cultural relics with familiar, everyday gestures.

Consider a holographically reconstructed 3D model of the Dream of the Red Chamber woodblock edition linked to a gesture interface. By rotating or tilting with the hands, visitors inspect carved lines and ink traces from multiple angles and at different scales. Rather than passively viewing a static reproduction, they can piece together how the block might have been carved and printed. The same technique applies to works such as the Yongle Encyclopedia and Zizhi Tongjian: rendered as three-dimensional, page-like forms, these texts respond to mid-air “page-turning” to move between sections, compare versions, or summon annotations tied to particular passages.

Designing such touchless interactions is especially pertinent for younger audiences accustomed to gesture-based interfaces on phones and game consoles. At the same time, it raises questions of ergonomics, accessibility, and cognitive load that call for iterative user testing. Used with care, gesture-controlled holographic displays complement more traditional presentations by offering an additional way to explore the structure and materiality of classical works and by opening a practical entry point into textual content that might otherwise feel remote.

5. Conclusion

Ancient books and related artifacts carry layered historical, textual, and artistic meanings. Yet the familiar toolkit of display cases, static labels, and minimal handling often narrows how visitors meet and make sense of them. Concerns about preservation and security—and the simple limits of space and time—further constrain presentations that might otherwise register the full complexity of these materials.

This study examined how virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) can be folded into the digital presentation of ancient books and artifacts at the National Museum of Classic Books. Focusing on oracle-bone inscriptions, the Dream of the Red Chamber woodblock prints, and immersive displays of classical texts, we sketched concrete scenarios in which holographic

projection, motion capture, AI-assisted restoration, and intelligent guide systems extend—rather than supplant—established exhibition practices. In particular, the joint use of holographic and AI techniques offers new ways to couple interpretive content with spatial design and visitor interaction.

These directions intersect with broader shifts across the cultural and creative industries, where digital platforms and data-driven services have taken on a growing role [7]. For the National Museum of Classic Books, measured experimentation with such tools can refine the design of digital exhibitions, open varied entry points into the world of ancient books, and document patterns of visitor engagement more systematically. Over the longer term, knitting together digital and physical approaches may support more sustainable strategies for preserving and communicating the heritage embodied in these collections, while leaving room for further work on evaluation methods, ethics, and inclusive design.

References

- [1] Liu, X., Li, K., Geng, G., & Zhou, M. (n.d.). Research progress of virtual reality technology in cultural heritage protection [Journal article/online first]. *Journal of Computer-Aided Design & Computer Graphics*.
- [2] Li, M. (2024). The digital Ansai art museum based on virtual reality and immersive interaction design. *Art Education Research*, (22), 55–57.
- [3] Gong, Z. (2024). Research on the innovative design of Dunhuang digital cultural and creative products under the background of cultural tourism. *Footwear Technology and Design*, 4(11), 18–20.
- [4] Ming, C. (2024). The application of immersive exhibition in museum displays: A case study of the National Museum of Classic Books. *Cultural Relics Authentication and Appreciation*, (14), 96–99. <https://doi.org/10.20005/j.cnki.issn.1674-8697.2024.14.024>
- [5] Song, Y., Huang, G., & Cui, S. (2024). Application of virtual reality and artificial intelligence technology in the virtual display and innovative design of Liannan Yao ethnic costumes. *Textile Report*, 43(12), 54–57.
- [6] Zhou, C., & Liu, S. (2024). Value realization of intelligent navigation systems in classic book exhibitions under the service design concept: A case study of the National Museum of Classic Books. *Library Journal*, 46(5), 81–85. <https://doi.org/10.14037/j.cnki.tsgxk.2024.05.011>
- [7] Zhao, H., Luo, S., Wang, X., & Wang, L. (2024). Progress analysis of the integration of holographic technology and artificial intelligence. *Integrated Circuit Applications*, 41(12), 120–121.