

New Pathways for Immersive Exhibition of Cultural Heritage: A Case Study of the Exhibition Philosophy and Visual Presentation of the “Canal Wonderland” Series at the Grand Canal Museum

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Abstract: Using the “Canal Wonderland” series at the Grand Canal Museum as a case study, this research examines the application models and visual presentation strategies of digital technology in immersive exhibitions of cultural heritage. Through literature review, case analysis, and visual-structural analysis, this study clarifies the background of digital development of Grand Canal culture and summarizes the characteristics of immersive exhibitions in content organization, spatial construction, and interactive mechanisms. The findings suggest that “Canal Wonderland” transforms linear cultural heritage into an accessible and participatory immersive experience through digital imagery, real-time motion capture, large-space positioning, and multimodal interaction, thereby enhancing the perceptibility of historical information and the experiential dimensions of cultural narration. Furthermore, the study points out that technology-enabled exhibition models can effectively enhance visitors’ sense of presence and cultural identity, providing new pathways for the revitalization of cultural heritage in the digital age. This research aims to summarize the rules and principles of digital exhibition of linear cultural heritage and offer theoretical reference and practical insights for immersive exhibition design and museum digitalization.

Key words: Grand canal culture; Immersive exhibition; Digital cultural heritage; Visual narrative; Interactive experience; Museum digitalization



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1 Digitalization of Grand Canal Heritage and the Development of the “Canal Wonderland” Exhibition

1.1 Historical Context and Digitalization Trends of the Grand Canal Cultural Heritage

The Grand Canal, an essential waterway linking northern and southern China, is the world’s earliest, longest, and

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Article Citation: Zhang, H. Y., Xiang, T. Y. (2025). New Pathways for Immersive Exhibition of Cultural Heritage:

A Case Study of the Exhibition Philosophy and Visual Presentation of the “Canal Wonderland” Series at the Grand Canal Museum. *Research on Art Design*, 1(1), 97-103.

largest man-made canal. It bears witness to the prosperity and exchange within Chinese civilization. Achieving an integrated presentation of this linear heritage is a major challenge for the Grand Canal cultural heritage. As a representative linear cultural heritage, the Canal spans numerous historical remains and diverse folk cultures along its route. During the “14th Five-Year Plan” period, national projects for safeguarding and revitalizing Chinese traditional culture, including the development of the Grand Canal National Cultural Park, have accelerated the digital protection, living inheritance, and modern utilization of the Canal’s cultural heritage. Under the frameworks of “Digital China” and “Culture-Powered Nation,” digital technology has become a key driver in innovating the dissemination of Grand Canal culture, shifting it from “static relics” toward “dynamic experience,” and from “material carriers” toward “digital narratives,” enabling audiences to perceive the cultural warmth and artistic spirit of heritage in blended virtual-real environments.

1.2 Emergence of Digital Practices Along the Grand Canal

In recent years, diverse digital explorations have emerged across regions along the Grand Canal, forming a cross-platform, multi-scenario, interdisciplinary system of digital practices. The immersive digital exhibition *Traversing Time and Space: The Grand Canal of China*, opened in Beijing on January 1, 2022, reconstructs historical scenes of the Canal through immersive visual storytelling. The AR interactive project at Qingming Bridge, Wuxi, embeds Ming–Qing transport scenes into actual streetscapes; in Jinan (Shandong), the digital restoration of the Nanwang Water Diversion Hub uses ground-penetrating radar and 3D reconstruction to “awaken” the underground “heart of the Canal” re-presenting the spectacular historical landscape. The “digital ontology” of the Grand Canal is not a substitute for its material body but a complementary and mutually enhancing structure that enriches the forms and pathways of cultural heritage dissemination. At the 4th Yangtze River Delta Cultural Expo in November 2023, Jiangsu’s exhibition area used AI technology to replicate heritage sites along the Canal, creating a virtual parallel space covering 6 provinces and 2 municipalities. At Tai’erzhuang Ancient City, MR technology recreated wartime memories, revitalizing national sentiment within digital contexts.

1.3 Transformation of Cultural Experience Driven by Digital Technology

Before the “Canal Wonderland” series, the “Immersive Panorama Canal” hall at the China Grand Canal Museum in Yangzhou had already used 5G + VR 720° technology to connect thousands of kilometers of waterways into a flowing digital scroll, allowing visitors to traverse time and space within a virtual canal environment. Such diverse cases demonstrate a shift in Grand Canal culture—enabled by digital technologies—from “viewable” to “perceivable” and “interactive”, proving that cultural heritage can present a new form in digital contexts where “authenticity, authoritativeness, and presence” coexist.

1.4 Functional Positioning of the Grand Canal Museum and Its Need for Immersive Exhibition

As the first national museum to present the Grand Canal across its full geographical and historical scope, the China Grand Canal Museum plays an important role in cultural dissemination and public education in the digital era. Researchers note that museums, as cultural microspaces, generate value not only through material display but also through dynamic fields of cultural identity formed through visitor-exhibit interaction. Digitalized museum displays thus go beyond presenting historical information—they strengthen emotional connections between audiences and culture through crafted immersive environments. With the acceleration of digitalization, the “Canal Wonderland” series

represents a leading immersive exhibition project expanding the narrative space of the Canal through digital technology. By integrating digital imagery, real-time rendering, motion-capture interaction, spatial soundscapes, and LBE large-space positioning into a coherent narrative system, it constructs an immersive Canal narrative based on temporal transformation and spatial continuity. Rather than simply recreating a historical segment, it uses cross-temporal, cross-regional, and cross-cultural visual continuity to present the Canal's depth, richness, and vastness in an interactive, experiential, and participatory way.

1.5 Developmental Logic and Technological Structure of the “Canal Wonderland” Series

The development of the “Canal Wonderland” series can be divided into three progressive stages.

During its exploratory phase, the project focused on aligning content expression with technological capabilities, testing narrative clarity and visual language adaptability through small-scale scenes, and using basic motion sensing and localized interactive modules to observe visitor behavior within immersive spaces.

In the system-integration stage, the project adopted 66-camera multi-view motion capture and 180 fps high-speed capture technology, enabling real-time transfer of user movements into the virtual environment. The 105° wide field-of-view and low-latency displays improved visual continuity, reducing the fragmentation common in early VR experiences. LBE large-space positioning supported simultaneous multi-user participation, shifting the experience from individual viewing to collective engagement.

Upon entering the mature stage, visual design, narrative organization, interaction modes, and spatial rhythm became fully unified. Continuous scenes were woven together through montage-like transitions, linking key historical episodes—from the excavation of the Han Canal by King Fuchai, to the Battle of Suiyang, to the flourishing Ming-Qing transport system, and imperial rituals—into a coherent visual narrative, presenting Canal civilization as a fluid dynamic scroll. Virtual-real layering and symbolic motifs formed cultural semantic chains; lighting, soundscapes, and spatial pathways created navigable immersion environments; behavioral triggers heightened participation, allowing visitors to experience history through embodied perception.

1.6 Breakthroughs and Values of the “Canal Wonderland” Exhibition Paradigm

“Canal Wonderland” represents an innovative breakthrough in traditional cultural heritage exhibition, forming a system supported by digital technology and centered on artistic expression. Guided by the principle of “scholarship as foundation, technology as method, and art as purpose,” it achieves aesthetic re-creation grounded in verifiable cultural content, giving new vitality to Grand Canal culture in contemporary contexts. Through a “digitalization-artification-public engagement” pathway, the project expands the possibilities of cultural heritage dissemination and offers a replicable paradigm of immersive exhibition design for museums.

2 Visual Arts Presentation of the Canal Wonderland Series

2.1 Construction of a Digital Immersive Visual System

As China's first museum-originated gamified large-space VR project, the project positions itself as a leading digital

expression of Grand Canal culture, distinguished by its gamified approach and large-scale VR implementation. Its exploration at the visual-art level builds an immersive visual structure with historical narrative as its core and new media technologies as its driver. By organizing time, space, image, light, and bodily movement, it creates a visual experience distinct from traditional exhibitions. Digital technology enables “remote presentation, dynamic reconstruction, and immersive engagement,” shifting visual art from static viewing to embodied participation. The visuals do not merely recreate historical landscapes; rather, they employ artistic non-fictional storytelling, translating historical events, canal geography, and cultural motifs into visualized forms that allow visitors to gain subjective perception in virtual space.

2.2 Visual Organization of Historical Narratives

The visual narrative adopts a horizontal historical timeline and vertical geographical axis, incorporating major episodes such as the excavation of the Han Canal by King Fuchai, the Tang-era Battle of Suiyang, the Ming–Qing transport system, and the canal connections to the Forbidden City. These are arranged into a continuous visual scroll spanning over two millennia. Each scene is reconstructed artistically while maintaining historical accuracy, with coherent design of architectural scale, textural details, and environmental tonality, enabling rapid transitions from one era and location to another. This dual strategy—historical authenticity and artistic stylization—aligns with the principle of “readability–visibility consistency” in digital cultural heritage narratives.

2.3 Film-Grade Visual Production and Immersive Effects

The exhibition incorporates film-level image-generation techniques, achieving wallpaper-grade resolution in each frame. The 105° ultra-wide field-of-view and ultra-low-latency rendering eliminate visual discontinuities common in conventional VR, creating a continuous immersive canal landscape. When visitors adopt a bird’s-eye view, seamless transitions reveal grand scenes of the thousand-mile transport network. Layered depth of field and dramatized light–shadow relationships reorganize canal-side cities, docks, marketplaces, and daily life into a vivid spatial narrative with enhanced historical ambience.

2.4 Embodied Immersion through Visual-Bodily Interaction

The integration of vision and bodily interaction is a defining feature of the visual arts in “Canal Wonderland” Presence-feeling “being there” in a virtual context—is central to digital immersive experiences. Using a 66-lens panoramic motion-capture system with 180 fps precision, the exhibition registers even subtle visitor movements, instantly reflecting them in the virtual environment. Whether defending a city with a sword or moving rhythmically, bodily actions advance the narrative. VR’s structure of “immersion–interaction–feedback” elevates perceptual intensity, shifting visitors from observers to participants. Thus, visuals become not merely images to be viewed but dynamically generated scenes co-created with the visitor’s actions.

2.5 Multi-Spatial Visual Organization and Narrative Guidance through Character Design

Enabled by LBE positioning, a 350 m² physical space is mapped into multilayered virtual visual fields in which visitors move freely. As viewpoints shift, visuals adjust dynamically, offering varied compositions of the same scene and transforming linear narratives into multi-branch narrative structures. The guiding character “Anlan, the River Spirit” serves as a visual and kinetic cue throughout the experience, directing attention and anchoring narrative progression within an open space.

2.6 Cinematic and Symbolic Visual Language

“Canal Wonderland” borrows cinematic techniques such as push–pull shots, montage transitions, and rhythmic editing to synchronize narrative pace and visual rhythm. For instance, cold high-contrast lighting creates tension during the Battle of Suiyang; warm tones and fluid lighting express commercial vibrancy in transport scenes; and low-illumination reflective lighting evokes tranquility and order at nighttime docks. Recurring visual motifs—water ripples, boats, lanterns—function both as scene elements and cultural symbols, forming a recognizable visual identity of Canal civilization and aligning with memory studies’ emphasis on symbol-reinforced cultural recollection.

2.7 Innovative Virtual-Real Visual Expression in Digital Art

The exhibition integrates innovative digital art techniques such as holographic dynamic imaging, virtual character rendering, and multi-layer spatial perspective. Each segment adopts a hybrid visual method—real-time particle effects simulate rippling water, while buildings, boats, and figures are rendered in stylized forms, balancing realism and expressiveness. This dual-mode visual strategy allows viewers to oscillate between knowledge and aesthetic experience, perceiving history while engaging with a poetic visual sensibility.

2.8 Cultural Narrative Function and Artistic Value of Visual Presentation

The visual arts of the “Canal Wonderland” series constitute not just a technologically driven presentation but a culturally narrative-centered visual reconstruction. Historical archives, visual motifs, digital imagery, and bodily interaction converge into a unified visual system, turning immersive space into a stage for cultural narration. Through comprehensive design of time, space, light, shadow, and bodily motion. Whether this approach constitutes a new paradigm is a subject for further discussion, but it demonstrates a clear synthesis of cultural, artistic, and technological elements in visual storytelling. This paradigm provides a reproducible and extendable model for the visual expression of linear cultural heritage and offers new theoretical perspectives for digital cultural heritage studies. The long-standing principle—“scholarship as foundation, technology as method, art as purpose”—applies not only to Dunhuang but to the entire field of cultural heritage. Heritage embodies profound cultural, historical, and technological value; only continuous scholarship ensures solid foundations. Building upon digital achievements and advanced technologies, new visual modes of digital art can integrate scholarship, technology, and art to serve the public’s cultural needs.

3 Innovative Directions for Immersive Cultural Heritage Exhibition

3.1 Deep Integration of Cultural Narrative and Immersive Technology

Innovation is the core force sustaining immersive exhibitions and the key to revitalizing Grand Canal culture in contemporary dissemination. Based on experiences from multiple Canal-themed immersive exhibitions—particularly the explorations of “Canal Wonderland” in visual presentation, narrative structure, and spatial technologies—innovative directions can be summarized as conceptual, content-based, formal, and technical craftsmanship innovations.

Conceptual innovation centers on the deep integration of cultural narrative and immersive technology. As a linear cultural heritage with vast spatial and temporal dimensions and complex cultural elements, the Grand Canal is difficult

to fully present within conventional museum spaces. Immersive exhibition transforms complex historical information into experiential content through digital visual language, real-time interaction, and spatial narration, meeting public demand for high-quality cultural experiences. According to the “Three-Realm Theory,” immersive experiences evolve from the physical realm (wujing) to the situational realm (qingjing) and finally to the ideational realm (yijing). Digital immersive spaces form the physical realm; interactive narrative mechanisms construct situational engagement; and cultural meaning and empathy guide visitors toward the ideational realm. “Canal Wonderland” demonstrates this layered construction, giving new vitality to Canal culture as a people-centered cultural service.

3.2 Digital Reorganization and Contemporary Expression of Cultural Elements

Content innovation lies in the fusion of historical culture with contemporary contexts. The Canal’s cultural system—spanning hydraulic engineering, transport networks, urban morphology, and folk life—is rich yet complex. Immersive exhibitions reorganize these elements through thematic structuring, symbolic extraction, and scenographic translation. Using time–space transitions as narrative cues, “Canal Wonderland” unfolds key cultural nodes—such as the excavation of the Han Canal, defense of Suiyang, prosperity of transport systems, and palace rituals—within a continuous spatial flow, allowing audiences to intuitively grasp the cultural evolution of the Canal. This digital restructuring aligns linear cultural heritage with contemporary aesthetic and cognitive modes.

3.3 Multimodal Technologies for Embodied Immersive Experience

Formal innovation emphasizes multimodal presentation—visual, tactile, auditory, and kinetic. With advancements in VR, AR, real-time rendering, and LBE positioning, immersive exhibitions have evolved into multisensory experiences. The 66-camera motion-capture and 180 fps system allows visitor actions to dynamically drive the virtual narrative; 105° ultra-wide visuals and low-latency output enhance presence; spatial sound and environmental lighting construct a walk-in environment. Cultural cognition emerges when the visitor’s personal space overlaps with cultural space. These multimodal integrations establish immersive exhibitions as embodied experiences rather than visually centered displays.

3.4 Technical Systems and Production Methods for Immersive Exhibitions

Craftsmanship innovation focuses on sustainable, modular, reusable, and tourable production methods. Immersive exhibitions involve image generation, installation construction, lighting, and spatial configuration. Modular and standardized digital assets, lightweight installations, and expandable space structures—as used in the “Canal Wonderland” series—enable rapid deployment across venues, reducing cost and enhancing dissemination. Digital content coupled with physical craftsmanship, such as virtual restoration of hydraulic structures and digital reinterpretation of waterway imagery, ensures both artistic appeal and scholarly rigor.

3.5 Universal Significance and Exhibition Principles of Innovative Directions

The above innovative directions, distilled from the “Canal Wonderland” experience, also apply broadly to other cultural heritage types. Immersive exhibitions must uphold objectivity, authenticity, and rigorous historical grounding. All presented content must derive from reliable historical documentation and scientific digitalization. Exhibition planning should be rooted in accumulated scholarship, integrating digital technology and artistic interpretation to build knowledge-based, aesthetically compelling, and participatory content suited for public audiences. Therefore, “scholarship

as foundation, technology as method, art as purpose” serves as a universal methodology for immersive cultural heritage exhibition. As crucial carriers of Chinese civilization, cultural heritage requires innovative digital expression to regenerate cultural value, deepen experiential participation, and strengthen cultural confidence in the new era.

4 Conclusion

General Secretary Xi Jinping emphasizes that “culture is the soul of a nation... Without a high degree of cultural confidence and cultural prosperity, there will be no great rejuvenation of the Chinese nation.” As a world-class linear cultural heritage, the Grand Canal’s digital exhibition constitutes not only a technological innovation but also an essential pathway for cultural communication in the new era. The “Canal Wonderland” series expands the expressive methods of Canal culture through immersive visuals, interactive narratives, and hybrid virtual–real spatial experiences, enabling the public to gain more intuitive cultural understanding and emotional resonance in digital environments. Moving forward, digitalization of the Grand Canal must continue to integrate academic rigor with technological innovation. Through open immersive exhibition models, China can tell its cultural stories more effectively, enhance cultural identity, and support the living transmission of heritage in the digital age.

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