

Revitalization and Renewal of Historic and Cultural Districts through Digital Game Interaction

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ABSTRACT

As vital carriers of cultural genes, historic and cultural districts face challenges such as the disappearance of authentic daily life, disordered streetscape, fragmented heritage, and delayed digital adoption. Taking interactive design in digital games as a point of departure and drawing on the "element-structure-scene" narrative framework from *The Legend of Zelda: Breath of the Wild*, this paper proposes a virtual-real synergistic path to revitalization. By utilizing CIM platforms and digital twin technologies to precisely extract cultural elements, and connecting fragmented heritage nodes through gamified IP design, immersive themed routes are constructed with the help of VR technology to dynamically reproduce historical scenes. Using Quanzhou's Zhongshan Road as a case study, the research integrates cloud-based intelligent control, a memory-fragment narrative system, and meteorological sensing technologies to optimize traffic flow and overlay ancient-modern scenes. This verifies a systematic solution for cultural continuity and spatial renewal driven by digital technology, offering an interdisciplinary methodology for historic district revitalization.

KEYWORDS

Digital applications; Digital game interaction design; Revitalization and utilization; Historic and cultural districts; Historical space

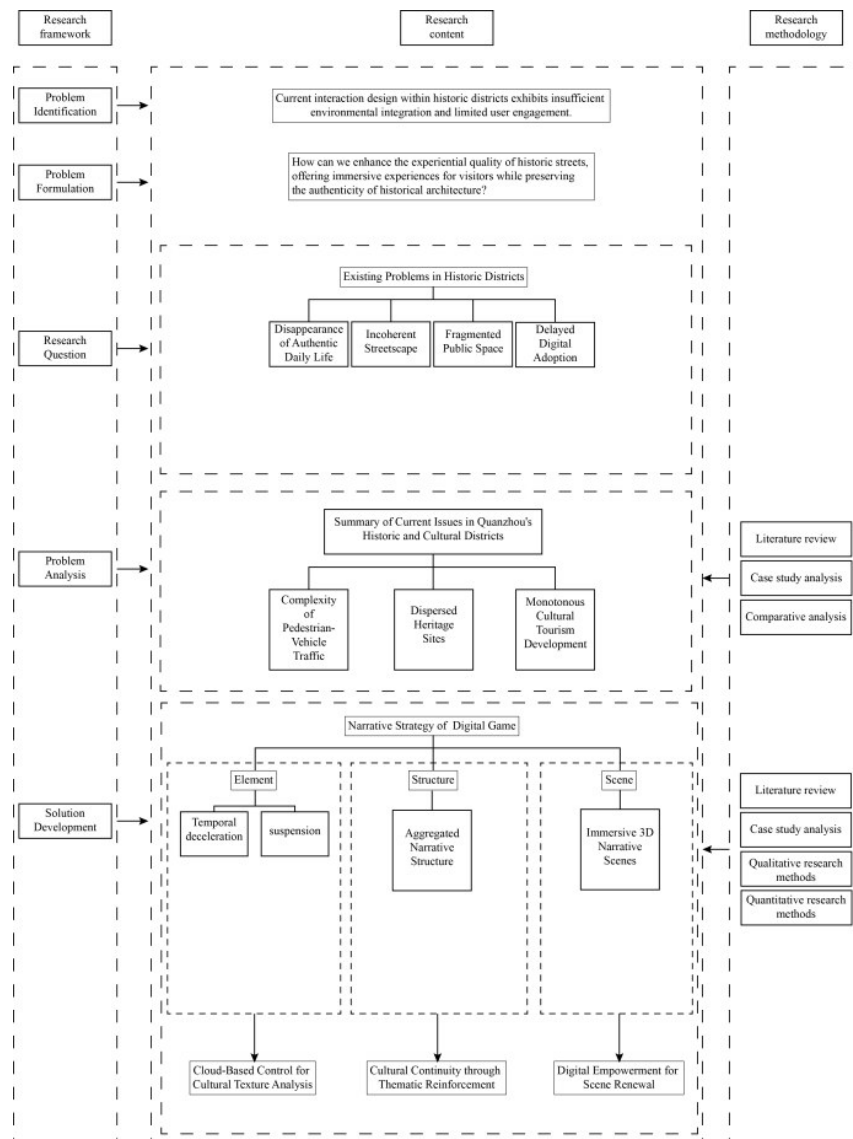
1 Introduction

As societal awareness evolves, the significance of preserving these districts has become increasingly recognized. The application of virtual reality technology in cultural heritage preservation was explored as early as November 1995 at the Virtual Heritage Conference in Bath, UK. In recent years, current preservation strategies, as proposed by numerous scholars, prioritize protection, public participation, dynamic updates, and long-term management, with a focus on resident needs and the classification and selective renovation of historical structures.^[1] The "Opinions on Promoting the Implementation of the National Cultural Digitalization Strategy" issued in May 2022, aims to achieve universal sharing of digital cultural achievements by 2035. Consequently, smart technologies are being implemented in the renovation and preservation of historical districts. For instance, in 2022, the Nanqu district of Fuxing City, Shandong, initiated the development of China's first urban historical district "metaverse." Gao Xiaoyu et al. (2024) utilized grounded theory to clarify the preservation strategies for Suzhou Pingjiang Historical and Cultural District,^[2] while Yang Tao et al. (2024) employed digital twin methods for the protection and revitalization of historical and cultural heritage in Suzhou's ancient city.^[3] Current research primarily focuses on the application of digital technologies in the preservation and transmission of historical and cultural districts and the enhancement of digital game interaction methods through emerging digital technologies. However, there is a scarcity of research integrating digital game design principles into the interactive design of historical and cultural districts. This area still requires exploration in combining traditional spatial planning with new media technologies. Integrating digital game interaction design principles with technologies like virtual reality can enhance the experiential quality of historical and cultural districts, increase visitor engagement with the historical built environment, and offer novel approaches to the revitalization and restoration of historical streets.

2 Current issues and research review in the revitalization of historic districts

Historic district revitalization faces multiple challenges: authentic daily life scenarios are fading due to over-commercialization; building aging, incoherent aesthetics, and outdated infrastructure are prevalent; fragmented heritage nodes and isolated public spaces disrupt the continuity of cultural context; and existing studies often lack deep integration of interactive narrative logic. Meanwhile, the "element-structure-scene" narrative framework from *The Legend of Zelda: Breath of the Wild* offers distinct advantages in constructing virtual-real synergistic narrative maps, potentially transcending traditional planning limitations and supporting cultural continuity and scene innovation through an interdisciplinary methodology. The research ideas are shown in Table 1.

Table 1 Research idea



2.1 Analysis of existing problems in historic districts

(1) Disappearance of Authentic Daily Life

Most protection and renewal efforts focus on commercial, tourism, or real estate-oriented projects, often overlooking the traditional lifestyles of local residents and failing to deeply explore regional cultural characteristics.

(2) Incoherent streetscape

Buildings on both sides of Zhongshan Road have deteriorated over time. Some suffer from structural damage, and newly added components are often incongruent with traditional aesthetics. Additionally, public utilities such as pipelines are in poor condition due to lack of maintenance.

(3) Fragmented public space

Heritage spaces within the district are scattered and fragmented, making it difficult to form a coherent heritage network. Connections between nodes are weak, and the internal and external parts of the district are poorly integrated^[4].

(4) Delayed digital adoption

Currently, digital applications mainly focus on digital tourism and the archiving of historical heritage^[5]. However, how to effectively apply digital thinking in practice still requires further exploration.

2.2 Game strategy design research

2.2.1 "Element-structure-scene" narrative strategy

Narrative cartography, as a new subfield of cartography, integrates interactive maps with remote sensing imagery, audio, and video to help users understand where and how events occur over time and space, forming deeper insights into

the events themselves^[6]. This approach combines the spatial advantages of cartography with the temporal expression of narratology^[7]. Applying this theory to historic and cultural districts helps continue historical narratives, activate local character, and sustain cultural heritage while shaping regional identity.

Derived from video game design, the "element-structure-scene" narrative strategy incorporates narrative cartography and GIS technologies, embedding game-based narrative structures into spatial storytelling. This results in a framework particularly suited for the metaverse and blended virtual-physical spaces^[8]. Under the guidance of the narrative framework of 'element-structure-scene', firstly, the cultural elements of the historical and cultural neighbourhoods can be sorted out in depth, and a detailed and realistic narrative field can be constructed. Secondly, the aggregated narrative structure can be used as an axis to connect the separate cultural nodes within the historical and cultural neighbourhood. Finally, the scene design in the game can be referred to, and VR and other digital technologies can be used to achieve the reconstruction and renewal of the cultural scene of the historical and cultural neighbourhood. This paper focuses on several practically meaningful aspects of the strategy within the context of historic district revitalization.

2.2.2 Narrative elements

Temporal deceleration and suspension are two key features of time-based narrative elements, commonly seen in films and games. Three-dimensional (3D) game scenes, due to their multidimensional storytelling capabilities and rich details, can vividly externalize characters' subjective temporal perception and psychological trajectories, effectively strengthening users' sense of presence and emotional engagement.

For example, in the open-world game *The Legend of Zelda: Breath of the Wild*, the protagonist can use tools like Stasis and Link Time to slow or freeze time. (Figure 1) These mechanics not only deepen the player's understanding of the virtual world through implicit cognitive guidance, but also reshape the narrative space into an immersive storytelling field via controllable time-space parameters.



Figure 1 Link Time

2.2.3 Aggregated narrative structure

In an aggregated narrative framework, the storyline unfolds through multiple interconnected branches. Readers (or players) can select side plots based on personal preferences, all of which relate back to the central narrative and ultimately converge at key points—thus preserving narrative coherence while enhancing user agency.

For instance, in *Breath of the Wild*, when players explore the ancient shrine northwest of Hyrule's Mount Hebra, the game mandates acquiring cold-resistant gear. It offers three possible ways to obtain it (Figure 2), and completing any one path allows the player to proceed with the main storyline.



Figure 2 The map of Hebra Mount

2.2.4 Immersive 3D narrative scenes

3D digital scenes are characterized by diverse narrative elements and high realism. These scenes feature vast amounts of content across multiple types. Moreover, by integrating audiovisual perception and interaction technologies, the immersive quality of storytelling within 3D maps is greatly enhanced.

Take the snow mountain scene in *Breath of the Wild* as an example: the environmental system exhibits ongoing spatiotemporal changes. Characters and environmental elements can trigger various interactions—such as enemies melting ice with fire to rescue trapped allies—subtly teaching players about the effect of temperature on material states (Figure 3).



Figure 3 Link melts the ice with a flaming weapon

3 Constructing a revitalization method for historic districts based on digital game narrative strategies

Centering on the “element–structure–scene” narrative framework, the proposed revitalization design strategy begins by leveraging CIM platforms and digital twin technologies to extract cultural elements and analyze spatial conflicts, thereby generating accurate digital profiles. Next, through gamified IP design, fragmented heritage nodes are linked to strengthen immersive experiences along thematic routes. Finally, VR technologies are employed to dynamically reconstruct cultural scenarios. This methodology breaks through the static logic of traditional planning by creating a virtual-real collaborative revitalization path. Through aggregated narrative structures and interactive 3D scenes, spatial perception is reshaped, offering a technically viable and theoretically innovative paradigm for historic district revitalization.

3.1 Extraction of narrative elements in historic and cultural districts

Based on the foundational capabilities of CIM platforms, current-state diagnostics and value analysis of historic districts can be conducted. A digital twin model is constructed to reveal spatial conflicts emerging during the district’s development^[9]. By integrating spatial coordinates of heritage sites with dynamic pedestrian flow data, functional zoning plans and visitor circulation systems can be optimized within the digital twin environment, thereby establishing a coupling mechanism between spatial organization and human behavior patterns.

3.2 Reinforcement of thematic routes

By extracting distinctive local cultural symbols within the area, a dual-channel cultural dissemination path can be established. On one hand, scenario-based role-playing mechanisms guide participants to deeply engage with traditional production methods and everyday customs. On the other, a task-driven narrative framework connects dispersed cultural nodes via a system of passes and task lists. A progressive exploration mechanism is designed to continuously stimulate emotional resonance from visitors.

3.3 Cultural return and continuity of the district

Supported by advanced devices in smart interaction technologies and vast data resources, virtual reality can be used to digitally reconstruct panoramic scenes of historic districts with precision. VR-based design requires systematic collection and preprocessing of original materials in the early stage, followed by fundamental 3D modeling work. The mid-stage focuses on virtual spatial architecture development and interaction engine debugging. In the later stage, cross-platform adaptability and multi-terminal deployment strategies must be implemented^[10].

4 Application analysis of smart interactive renewal design in historic districts

This chapter takes Zhongshan Road in Quanzhou as an empirical case and analyzes the smart interactive design path from four dimensions: historical context, alleyway space, spatial conflicts, and dynamic transformations. By integrating cultural genes through cloud-based intelligent control, constructing a “memory fragment” narrative system, optimizing traffic flow with CIM technology, and recreating port trade and street life through layered VR scenes, the proposed framework demonstrates a systematic innovation for district revitalization driven by digital technologies. Features such as a timeline interface and meteorological perception are incorporated to enrich the experiential depth of historical scene

overlays.

4.1 Project overview

As one of the first nationally designated historic cities, Quanzhou is based on a triadic geographic foundation of “mountain – river – sea,” forming a unique urban morphology in Licheng that follows ecological textures, including a double-cross axis and dual tower landmarks. The city’s fishbone-shaped urban network is constructed upon the framework of “one vertical and two horizontals,” forming a double-cross street layout. Zhongshan Road Historic and Cultural District, running through the ancient city, serves as the central axis and was listed in China’s historic and cultural districts directory in 2015. This spatial corridor, emblematic of the Maritime Silk Road civilization, achieves a deep integration of marine trade culture and traditional urban wisdom through the co-narration of alleyway textures and architectural language. It serves as a key physical carrier for decoding Quanzhou’s urban cultural DNA.

4.2 Challenges in the conservation and renewal of quanzhou’s old town

(1) Complexity of Pedestrian-Vehicle Traffic

Ancient alleys interspersed throughout the old town create a complicated internal circulation. To accommodate both tourists wandering through streets and local residents going about their daily lives, specific street sections have been designated for pedestrian-only access or all-day non-motorized traffic^[11]. However, unaware tourists often enter alleys open to e-bikes, and the frequent passage of electric vehicles severely affects their visitor experience.

(2) Dispersed Heritage Sites

Current smart navigation infrastructure in the district is noticeably lacking. There is an absence of electronic guidance systems, and commonly used mapping platforms such as Gaode and Baidu have not updated the precise locations of 22 cultural heritage sites. Tourists often get lost in the maze-like alley network, significantly reducing the efficiency of their visits.

(3) Monotonous Cultural Tourism Development

Research indicates serious industry homogenization within the district, with a lack of diversity and fading regional characteristics. Intangible elements such as traditional crafts and folk festivals have not been effectively integrated into the industrial chain^[12]. As a result, deeper cultural capital remains underutilized, and the continuity of local heritage is under significant threat.

4.3 Strategic proposals

4.3.1 Cloud-based control for cultural texture analysis

Under the framework of digital humanities, a cultural regeneration strategy is proposed that includes a mechanism for collective memory digital archiving and cloud-based integration^[13]. Using intelligent interaction technologies, oral history materials from Zhongshan Road—such as tea art practices and opera appreciation—are structurally processed and distilled into systematic extractions of intangible cultural elements. This enables digital reconstruction and innovative expression of traditional living scenes.

This approach echoes the storyline of *The Legend of Zelda: Breath of the Wild*, where civilization is rebuilt after Calamity Ganon devastates the kingdom and the protagonist Link solves puzzles in ancient shrines to restore Hyrule. A similar narrative could be designed for the protection of Zhongshan Road, in which visitors assume the role of “cultural guardians.” Through completing tasks such as restoring virtual monuments or collecting lost traditional skills, they gradually “awaken” the vitality of the ancient city. This enriches the cultural landscape of Zhongshan Road while invoking collective memories among local residents. In terms of traffic planning, data collected via CIM technology can generate real-time visitor maps and alert users to avoid electric vehicle-congested routes, effectively mitigating fragmented experiences caused by traffic interference.(Figure 4)

4.3.2 Cultural continuity through thematic reinforcement

To address poor map display effectiveness, the spatial narrative theory from *Breath of the Wild* can be adopted to build narrative-style digital maps. In the game, Link pieces together the history of Hyrule by collecting memory fragments. Similarly, as the origin point of the Maritime Silk Road, Quanzhou contains scattered historical sites that can be linked through a “Memory Fragment” system. These fragments can be collected in any order and ultimately assembled into a complete “Epic of Maritime Quanzhou,” reflecting the aggregated narrative structure and free exploration found in the game.

For the Wenmiao and Jinyuxiang areas, a narrative network centered on Zhongshan Road’s historical corridor is

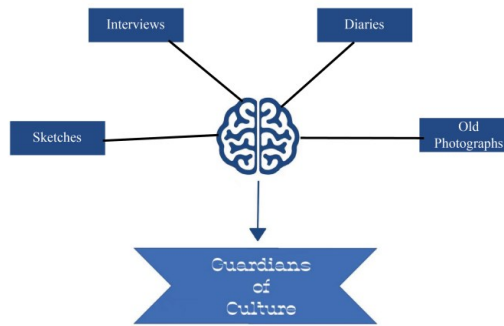


Figure 4 Cloud-based information collection

proposed. Opera-inspired symbols and Confucian ritual elements can be used to link the Wen Temple, ancestral halls, and the Bagua Canal. For the Zhenfu Alley heritage residences, spatial connections between notable sites such as the Huang Residence and Ye's Overseas Mansion can be formed to promote the spread of celebrity culture. For Huaxiang's traditional residential-commercial zone, resources like Xichun Palace and the Quanzhou Puppet Theater can be integrated, and new task points added where visitors can experience bamboo weaving and floral craftwork as part of intangible cultural heritage.(Figure 5)

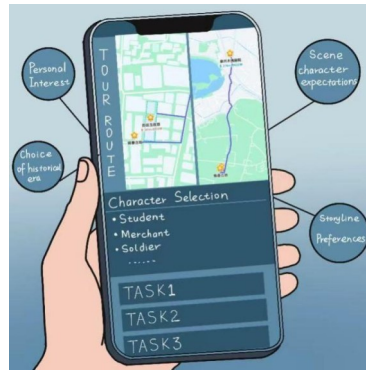


Figure 5 Intelligent guide line generation

4.3.3 Digital empowerment for scene renewal

Historically, Quanzhou was a hub of multicultural integration—home to Arab merchants, Persian believers, and Southern Fujian clans—earning it the title “Museum of World Religions.” Likewise, in *Breath of the Wild*, Hyrule is home to the Zora, Goron, and other races, each contributing unique civilizations. Drawing from this, four major VR-based scenes are proposed to empower distinct cultural experiences:

(1) Ancient Port:

Users interact with 3D-modeled Arab merchants to simulate spice trade scenarios, recreating the vibrancy of maritime commerce (Figure 6).

(2) Old Town Streets:

Motion capture technology reproduces everyday cultural elements such as the floral hairpin tradition. The multicultural fusion of architecture is modeled parametrically.

(3) Quanzhou Confucian Temple:

Visitors wearing AR devices can activate a classical reading interaction module and engage in cross-temporal dialogue with virtual scholars.

(4) Quanzhou Puppet Theater:

Users can transcend time and watch ancient puppet performances as they once occurred.

(5) Additionally, a “timeline” control interface can be introduced to enable historical comparisons. For example, scanning QR codes in the alleyways triggers a “temporal stasis” mode, overlaying historical imagery with present-day scenes through augmented reality. Combined with meteorological sensors, the system dynamically switches VR scenes based on weather: sunny days reveal bustling ancient markets, while rainy days showcase teahouses playing Southern Min opera. Visitors can interact through gestures—such as lighting virtual lanterns—to illuminate the scene.



Figure 6 Virtual scene effect display

5 Conclusion

This study adopts digital game narrative strategies as its point of departure, proposing an “element–structure–scene” framework to construct a virtual-real collaborative path for revitalizing historic districts. By utilizing CIM platforms, VR technology, and gamified IP design, the approach enables the precise extraction of cultural elements, immersive integration of thematic routes, and dynamic reproduction of historical scenarios. The academic contribution lies in breaking away from the static logic of traditional planning, incorporating game design thinking such as aggregated narratives and 3D interaction into cultural heritage preservation. This offers an interdisciplinary methodology for cultural continuity and spatial renewal in historic districts.

However, the study has certain limitations: the implementation of digital technologies relies on high-cost infrastructure, making it difficult to promote in small or medium-sized districts; case validation is centered on Quanzhou’s Zhongshan Road, and generalizability requires further multi-regional empirical research; the integration of resident participation mechanisms remains underdeveloped, and the social sustainability of revitalization efforts warrants further exploration.

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