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Innovation and Development of Digital Projection Art in Cultural Tourism Projects in the Context of New Media Art

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Abstract: Against the theoretical background of the media turn in new media art, this study examines the mechanisms through which digital projection art generates innovation in cultural tourism projects across technology, spatiality, narrative, interaction, and communication. Using a combination of literature analysis, case synthesis, and comparative analysis, the study examines the evolution of digital projection art, its application logic in cultural tourism, and its practical challenges from four dimensions: technological media, spatial narrative, interactive experience, and cultural communication. It further develops a four-dimensional evaluation framework encompassing technology, experience, culture, and communication, and proposes an innovation pathway of cultural anchoring, spatial narrative, interactive generation, and data feedback. The study argues that the value of digital projection depends not on equipment specifications or visual spectacle per se, but on whether technology can be effectively coupled with cultural content, spatial structures, and visitor behavior. Digital projection can therefore evolve from a conventional visual display tool into a spatial medium capable of producing cultural meaning. In applying digital projection to cultural tourism projects, practitioners should avoid technological homogenization and the superficial treatment of cultural symbols, and establish an innovation mechanism grounded in cultural authenticity, centered on spatial narrative, supported by moderate interaction, and safeguarded by continuous evaluation. The findings provide references for theoretical research on digital projection art, digital transformation in cultural tourism, and the design and evaluation of immersive cultural spaces.

Keywords: Digital projection art; New media art; Cultural tourism; Spatial narrative; Interactive experience; Digital cultural communication

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1. Introduction

With the continuous evolution of digital technologies, new media art has become an important field of contemporary art, reconstructing modes of artistic expression and audience interaction through digital and network technologies [1]. Amid the global wave of digitalization, the digital transformation of cultural tourism

has become an established trend, and leveraging digital technologies to enhance the competitiveness of cultural tourism has emerged as a central concern for both academia and industry [2].

As an important form of new media art, digital projection art has considerable potential for application in cultural tourism settings because of its visual presentation capabilities and technological support. Digital projection can enhance the attractiveness of cultural tourism through immersive experiences and interactive design [3], while digital art enables audiences to participate in, manipulate, and even co-create artworks, providing an important theoretical basis for this study [4].

Current applications of digital projection in cultural tourism face challenges including high technical implementation difficulty, limited visitor participation, and superficial cultural interpretation. Existing studies have largely focused on the technological value of new media art, digital cultural tourism, and immersive experience, often treating digital projection as a tool for scene enhancement. Systematic discussion remains limited regarding the role of projection in constructing cultural meaning, the influence of spatial structures on narrative, and the ways in which visitor interaction can reshape artworks. Accordingly, this study conceptualizes digital projection as a spatialized new media medium and moves beyond a technology-application perspective to examine its mechanisms of narrative, experience, and cultural communication. Rather than focusing on demonstrating technological sophistication, the study seeks to explain how technological capabilities are transformed into cultural and experiential value and to develop an evaluation framework and innovation pathway.

The contributions of this study are threefold. First, digital projection is redefined from a mere display technology as a composite medium that connects cultural content, architectural space, and visitor behavior. Second, spatial narrative and interactive generation are integrated into an analytical framework to explain how projected images generate meaning through changes in viewers' bodily movement and environmental conditions. Third, a four-dimensional evaluation framework of technology, experience, culture, and communication is developed, together with an implementation pathway of cultural anchoring, spatial narrative, interactive generation, and data feedback, thereby addressing the practical challenges of cultural tourism projects that emphasize visual technology while neglecting cultural interpretation and long-term operation.

2. Digital projection art and the current state of cultural tourism projects

2.1. Research on new media art

As an emerging form integrating technology and art, new media art has developed rapidly since the late twentieth century and has become an important component of contemporary art. New media art creates a distinctive synergy between users and technology, providing interactive experiences that are difficult to achieve through traditional art forms [5]. By enhancing interactive experiences and optimizing visitor participation, new media art significantly improves the quality of cultural tourism experiences [6]. The integration of new media and cultural tourism enables innovative promotional strategies and effective value co-creation through user participation in content production. In addition, new media art has reshaped the communication of cultural tourism and strengthened connections between visitors and local heritage [7].

From a theoretical perspective, new media art does not simply replace traditional media with digital devices; rather, it changes the mode of existence of artworks, the relationships of communication, and the position of audiences in the participatory process. Manovich (2002) emphasizes characteristics including

numerical representation, modularity, automation, variability, and transcoding [1]. Accordingly, digital projection art is no longer simply a matter of "projecting images," but of using the variability of digital media to establish artistic systems that change with space, time, and audience behavior.

In cultural tourism settings, projection can transform architecture, heritage sites, and landscapes into programmable visual interfaces, giving static cultural objects a temporal dimension and narrative rhythm. Grau's (2003) research on the relationship between "illusion" and "immersion" demonstrates that immersive imagery has a long media history [8], with its core mechanism lying in altering viewers' perception of space through visual environments. Digital projection art therefore possesses both technological-media and artistic-expression attributes and should not be understood solely in terms of equipment and visual effects.

Overall, research on new media art provides this study with a theoretical foundation concerning media characteristics and audience participation. However, existing research has paid limited attention to how digital projection completes cultural translation in specific cultural tourism spaces and has rarely incorporated spatial structures, visitor behavior, and communication feedback into a unified analytical framework.

2.2. Development of digital projection art

As an important branch of new media art, digital projection art uses digital technologies to project images, videos, animations, and other content onto physical surfaces, creating visual effects that combine the virtual and the real. Its development can be traced back to the 1980s, when advances in computer graphics and digital display technologies facilitated its emergence. By the 1990s, improvements in high-resolution projection equipment and computing capabilities enabled digital projection art to be widely used in art exhibitions and public spaces. Entering the twenty-first century, digital projection art continued to develop as projection equipment became more compact and intelligent, and projection content became increasingly diverse. Artists have continuously explored new forms and technical approaches, promoting its broad application across different fields. Digital projection art has gained wide recognition for its effectiveness, communicative capacity, interactivity, and experiential qualities [9]. Its application in cultural tourism projects has also become increasingly widespread, making it an important means of promoting innovation and development in cultural tourism.

The development of digital projection art has not been a linear process of equipment upgrading; rather, it has been jointly driven by advances in display technologies, computer graphics, digital image production, sensors, and real-time interaction. Improvements in brightness, resolution, edge blending, geometric correction, and real-time rendering have enabled projected imagery to conform more accurately to building façades and irregular structures. Projection mapping has consequently developed strong spatial adaptation capabilities, allowing architecture itself to participate in visual narrative. Related research has also begun to shift from technical feasibility toward cultural information transmission and visitor-experience evaluation [10].

At the same time, digital projection has gradually shifted from "pre-produced playback" toward "real-time generation." Interactive projection incorporates cameras, depth sensors, and motion capture into the structure of artworks, making audience behavior a trigger for changes in imagery. The artwork is consequently generated through the relationships among the creator, system, audience, and space.

From a research perspective, studies of technological evolution have sufficiently demonstrated the spatial adaptation and real-time interaction possibilities of projection mapping. However, further questions remain: How can technological adaptation be transformed into cultural narrative? How do spatial interfaces influence visitors' understanding? These questions constitute the focus of the analysis below. After clarifying

the media evolution of digital projection, it is also necessary to examine it within the industrial context of the digital transformation of cultural tourism.

2.3. Digital transformation of cultural tourism projects

Cultural tourism projects enhance tourism attractiveness and visitor satisfaction through cultural experiences. With the rapid development of digital technologies, the digital transformation of cultural tourism projects has become an overarching trend. This transformation aims to comprehensively upgrade various aspects of cultural tourism projects through digital technologies, thereby improving competitiveness and service quality. In recent years, Chinese cultural tourism enterprises have actively promoted industrial digitalization, innovated cultural tourism scenarios through digital technologies, introduced digital consumer products, and developed smart cultural tourism formats to achieve high-quality development [11].

Digitalization in cultural tourism does not mean that all traditional content must be technologized; rather, it requires rethinking how cultural resources are understood, communicated, and consumed through digital media. Experience economy theory emphasizes that spatial environments, plot organization, and participation processes constitute important sources of experiential value [12]. This implies that the value of digital projection lies less in the equipment itself than in its ability to transform cultural resources into experiences characterized by emotion, spatial rhythm, and participation mechanisms.

Accordingly, cultural tourism projects should establish a chain of "cultural resources–digital content–spatial settings–visitor behavior–experiential feedback" to avoid the tendency to prioritize construction while neglecting operation. The core of digital transformation is not "technology substitution," but the use of technology to reorganize cultural content, spatial experiences, and visitor relationships.

With the empowerment of new technologies, the media ecology is undergoing profound transformation. This not only brings changes in users' consumption habits and challenges to promotional and operational concepts, but also creates new opportunities for the cultural tourism industry in technology-driven development, content expansion, and brand building [13].

Digital projection art plays an important role in this digital transformation. On the one hand, it enriches the content and forms of cultural tourism projects, providing visitors with visual experiences and a sense of immersion. On the other hand, digital projection art enables personalized and customized design to meet the needs of different visitors. Through digital projection, historical and cultural stories can be presented visually, allowing visitors to experience a cultural atmosphere. Combined with technologies such as virtual reality and augmented reality, digital projection can also create more immersive experiential spaces.

Existing research on digital cultural tourism and immersive experiences provides this study with insights into experience economics and operational feedback. However, most studies remain focused on technological applications and descriptions of experience, with limited discussion of the mechanisms of digital projection through the complete chain of "cultural authenticity–spatial narrative–interactive generation–communication feedback." This gap provides the entry point for the present study.

3. Mechanisms of digital projection art in cultural tourism projects

3.1. Types of digital projection applications in cultural tourism and mechanisms of cultural translation

As an emerging art form, digital projection art has been widely applied in various cultural tourism projects

and demonstrates diverse types and technological characteristics. Major types include augmented reality projection, interactive projection, immersive projection, and holographic projection. Each type has distinctive technical characteristics and application contexts. Augmented reality projection overlays digital content onto real-world scenes to create a visual effect combining the virtual and the real [14]. Interactive projection emphasizes audience participation and enables real-time interaction between people and projected content through sensing technologies [15]. Immersive projection uses multi-surface or surrounding projection to create an all-encompassing immersive experience. Holographic projection employs optical technologies to present three-dimensional images, creating the visual effect of objects floating in space. These technological characteristics enable digital projection art to provide diverse experiential modes in cultural tourism projects, thereby enhancing visitor participation and satisfaction.

The four types above are not mutually exclusive and often appear in hybrid forms in actual projects. Rather than classifying them by equipment type, digital projection can be understood along three dimensions: spatial scale, interaction depth, and narrative mode. Spatial scale ranges from cultural artifacts and buildings to exhibition halls and open landscapes; interaction depth can gradually progress from one-way viewing to co-creation; and narrative modes can develop from linear presentation to branching exploration.

In cultural heritage settings, the advantage of projection mapping lies not only in attracting visitors but also in transforming historical information that is difficult to observe directly into visual narratives with a temporal dimension [16]. However, when imagery lacks a meaningful connection to the cultural value of the site, visual effects may instead result in "technology overshadowing content." Li and Ito (2023) argue that the evaluation of projection-mapping projects should consider dimensions including cultural understanding, information retention, and negative experiences [16].

From the perspective of application mechanisms, digital projection forms at least three modes of cultural translation: reproduction, interpretation, and recreation. Reproduction emphasizes historical evidence; interpretation emphasizes knowledge communication; and recreation emphasizes artistic expression. When historical information is uncertain, artistic imagination should not be presented as fact, so as to maintain the credibility of cultural communication.

3.2. Typical application cases and mechanism analysis

To make the case synthesis more comparative, this study selects the immersive art exhibition "Exploring the Classic of Mountains and Seas: Why Kunlun," the "Boundless · Illusory Realm" immersive international light-and-shadow theme park, Shanghai Disney's "Zootopia Celebration Projection," and Xi'an Tang Paradise's "Dreams of the Tang Dynasty" as representative cases. The cases are compared across six dimensions: projection type, spatial scale, interaction depth, narrative mode, cultural translation, and major challenges. Case materials are drawn from publicly available reports, including China News Service, CNR, the official website of the Qinghai Provincial People's Government, Guangming Online, official information from Shanghai Disney Resort, and Xi'an Daily.

Table 1. Multidimensional comparison of typical cases

Comparison Dimension	Exploring the Classic of Mountains and Seas: Why Kunlun	Boundless · Illusory Realm	Shanghai Disney's Zootopia Celebration Projection	Xi'an Tang Paradise's Dreams of the Tang Dynasty (2026 Updated Edition)
Projection Type	Gesture-interactive projection / gauze-screen imaging / holographic light and shadow	3D Mapping / lighting / projection / interactive installations	Projection on castle architecture	Water screen / gauze screen / naked-eye 3D / panoramic laser
Spatial Scale	Museum exhibition space	Outdoor ecological island, garden landscape	Theme-park castle façade	Open landscape performance; 300-mu Furong Lake
Interaction Depth	Medium to high interaction	Immersive walking experience; multi-scene interaction	Spectator-oriented	Boat-based moving-viewing experience
Narrative Mode	Mythological IP narrative; science popularization + art	Nonlinear exploration; light-and-shadow narrative	Plot-driven, IP-based	Linear performance narrative
Cultural Translation	Recreation	Recreation	Recreation	Reproduction and recreation
Main Challenges	Cultural anchoring needs strengthening	Weak cultural anchoring; relies heavily on light-and-shadow atmosphere	Limited cultural authenticity; relies on IP content	Pressure from operational updating and heritage conservation

3.2.1. "Exploring the classic of mountains and seas: Why Kunlun" immersive art exhibition

The immersive art exhibition "Exploring the Classic of Mountains and Seas: Why Kunlun" opened at the Qinghai Art Museum on July 9, 2026, and is scheduled to run through late October. Organized by the Publicity Department of the Qinghai Provincial Committee of the Communist Party of China and Qinghai Publishing & Media Group Co., Ltd., it is a major cultural tourism activity of the "Xihai 2261 · Hehuang Cultural Festival." The exhibition is divided into four major sections—historical popularization, art display, digital interaction, and participatory activities—with 16 sub-exhibition areas in total. Static displays constitute the main format, supplemented by digital interaction.

The digital interaction section integrates technology with traditional culture and features three immersive light-and-shadow zones: "Four Celestial Spirits," "Characters in the Mountains and Seas," and "The Lost Valley Flower of the Classic of Mountains and Seas." In "Four Celestial Spirits," projected images of the four mythological guardians fill the entire space, and visitors can trigger the projections through hand gestures. The "Characters in the Mountains and Seas" zone likewise allows visitors to trigger projected mythical creatures by waving their hands. The "Lost Valley Flower of the Classic of Mountains and Seas" zone combines gauze-screen imaging, holography, and an infinity mirror to create an illusion of a floating nine-tailed fox. The participatory section includes a children's coloring-to-screen interaction and China's first large-scale VR spatial experience themed on the Classic of Mountains and Seas. Visitors can photograph immersive light-and-shadow scenes featuring the "Four Celestial Spirits" and Mount Kunlun (see Figure 1).

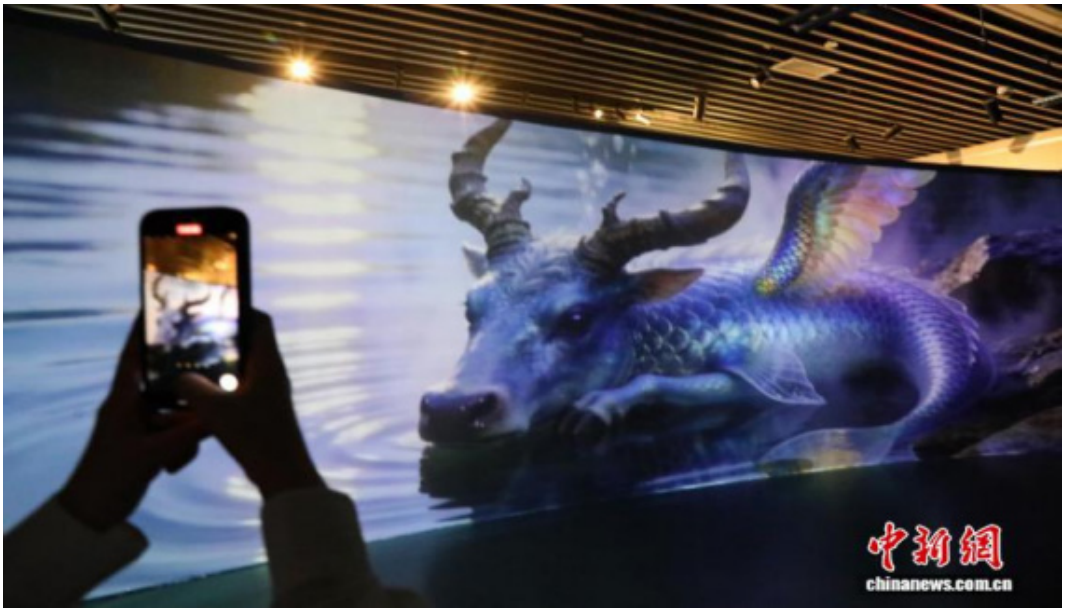


Figure 1. Visitors photographing the immersive light-and-shadow scene featuring the "Four Celestial Spirits" and Mount Kunlun.Source: China News Service; photograph by Ma Mingyan.

The key feature of this type of exhibition lies in transforming classical texts into visual light-and-shadow narratives and lowering the threshold for cultural understanding through gesture-based interaction. However, its cultural translation is primarily a form of "recreation," and care must be taken to prevent artistic imagination from replacing cultural interpretation. The exhibition closely aligns with Qinghai's local cultural context and is linked to the Hehuang Cultural Festival. Its model of "static display + digital interaction" also provides a reference for the digital transformation of small- and medium-sized art museums.

3.2.2. "Boundless · Illusory Realm" immersive international light-and-shadow theme park

The "Boundless · Illusory Realm" immersive international light-and-shadow theme park is located on the Hutuo River Art Ecological Island in Zhengding County, Shijiazhuang, Hebei Province. Covering approximately 90,000 square meters with a total investment of RMB 53 million, it is the first original immersive international light-and-shadow art IP in Hebei Province and opened to the public in 2021. The project uses modern digital technologies—including lighting, projection, original music, interactive installations, audiovisual installations, and 3D Mapping—to transform existing garden landscapes through projection mapping and create 12 major immersive light-and-shadow art spaces: "1 Light Trail," "2 Dawn," "3 Twilight," "4 Genesis," "5 Order," "6 Poetry of Light," "7 Starshine," "8 Night Song," "9 Forest Spirit," "10 Illusory Realm," "11 Boundless," and "12 Rebirth of All Things" (see Figure 2).

Using an "island light-and-shadow +" model, the project integrates diverse interactive experiences, including murder-mystery games, drama, live performances, camping, and themed festivals, into the light-and-shadow program to create a new immersive nighttime tourism experience. In 2022, the project was selected as a "2022 Smart Tourism Innovation Project" (source information to be further verified). The park is normally open from Tuesday to Sunday evenings and closed on Mondays; specific hours are subject to the attraction's official real-time announcements.



Figure 2. Night view of the "Boundless · Illusory Realm" immersive international light-and-shadow theme park.Source: Guangming Online, special report on the "2022 Smart Tourism Innovation Projects."

The project's mechanism lies in coupling projection mapping with garden-landscape space, allowing natural space to function as an interface for image generation. Its advantage lies in the immersive walking experience: visitors do not watch from fixed seats but gradually piece together the light-and-shadow narrative while moving through the space. However, such projects can easily develop the problem of "strong visual atmosphere but weak cultural memory" if they lack a stable cultural anchor.

3.2.3. Shanghai Disney's "Zootopia Celebration Projection"

As a Disney destination featuring the world's first and only Zootopia-themed land, Shanghai Disney Resort launched a themed projection show during the theatrical release period of Zootopia 2. The "Zootopia Celebration Projection" was presented from November 18, 2025, to January 27, 2026, each day before the "ILLUMINATE! A Nighttime Celebration" show at Enchanted Storybook Castle. Based on the storyline of Zootopia 2, the projection show presents light-and-shadow adventures featuring characters such as Judy and Nick, accompanied by theme music performed by Shakira (see Figure 3).

The Zootopia-themed land uses animatronic technology, an upgraded building information model (BIM), and projection effects to reproduce, to the greatest extent possible, the characters and settings from the animated film. Such projects can flexibly adjust content according to narrative and temporal requirements and can therefore accommodate different thematic needs.



Figure 3. Shanghai Disney's "Zootopia Celebration Projection" presented on Enchanted Storybook Castle.Source: Xinhua News Agency; photograph by Liu Ying.

The advantage of this type of project lies in the coupling of IP-based narrative with spatial entertainment. However, its cultural translation is primarily a form of "recreation," and care should be taken to avoid equating cultural expression entirely with visual entertainment.

3.2.4. Xi'an Tang Paradise's "Dreams of the Tang Dynasty" (2026 Updated Edition)

"Dreams of the Tang Dynasty" is a large-scale immersive water-dance and light-and-shadow show at Xi'an Tang Paradise, operated by Qujiang Cultural Tourism Performing Arts. The show was officially renewed and relaunched in April 2026 and entered its regular performance season from April to October, beginning at 8:00 p.m. each evening with a duration of approximately 50 minutes.

The performance draws on the imperial garden landscape of Tang Paradise, using the 300-mu Furong Lake as a natural stage and the Ziyun Pavilion complex as a real-life backdrop. It adopts a boat-based moving-viewing format in which audiences become "dream seekers" upon boarding, creating a fully immersive experience in which "people travel through a painting and boats move through a dream" (see Figure 4). The production employs elevating water screens, multidimensional computer-controlled fountains, panoramic laser projection, building-scale naked-eye 3D projection, and an immersive surround-sound system; the main water screen reaches 20 meters in height. Structured around the poetic world of Li Bai, the performance integrates classic poems such as "Invitation to Wine" with music and dance, presenting epic scenes including Spring River and Moonlit Flowers, the Silk Road Camel Bells, Rainbow Skirts and Feathered Coats, and the Qujiang Banquet. It thereby creates a multisensory spectacle integrating water, light, image, buildings, and boats.



Figure 4. Boat-based moving-viewing format in "Dreams of the Tang Dynasty." Source: Xinhua News Agency; photograph by Wang Zhichao.

This type of project is well suited to open landscapes and performance spaces. Its boat-based moving-viewing design makes spatial movement itself part of the narrative rhythm. However, the relationship between historical authenticity and artistic imagination should be carefully managed to avoid excessive entertainment-oriented treatment.

The comparison above shows that different types of digital projection have distinct advantages and limitations in terms of spatial scale, interaction depth, narrative mode, and cultural translation. Museum galleries are more suitable for low-intervention, interpretive projection; outdoor ecological spaces are more suitable for immersive, exploratory projection; theme parks are more suitable for IP-based, entertainment-oriented projection; and open landscape performances are more suitable for audience-oriented, hybrid projection. The application of digital projection should not be determined by equipment type, but by cultural objectives, spatial conditions, and visitor behavior.

Projected imagery not only provides visual enjoyment for passive observers but also offers immersive experiences to active participants [17]. In some exhibition halls and museums within cultural tourism projects, holographic projection is used to display precious artifacts and historical figures, enabling visitors to gain a more vivid and intuitive understanding of history and culture. With its diverse forms and technological advantages, digital projection art enriches application scenarios in cultural tourism projects and improves experiential quality and viewing value. The cases above indicate that digital projection in cultural tourism has developed multiple application mechanisms while also revealing problems concerning cultural anchoring, interaction depth, and operational updating. The following section discusses innovation mechanisms and the evaluation framework on this basis.

4. Innovation mechanisms of digital projection art in cultural tourism projects

4.1. Innovation in technological foundations: From equipment-centered to system-centered design

Digital projection art plays a critical role in driving innovation in cultural tourism projects, particularly in

integrating traditional culture with modern technologies. With advanced digital technologies, historical sites and museums can reconstruct historical scenes and the original appearance of cultural artifacts, providing visitors with immersive and realistic experiences and thereby enhancing the attractiveness of cultural tourism projects [18]. Technologies such as digitization, modeling, holographic imaging, and virtual cultural-resource construction not only facilitate the dissemination of valuable historical and cultural resources but also support immersive visitor experiences. These technological innovations can promote coordinated development between tourism-oriented exploitation and the preservation of cultural resources, thereby contributing to transformation and progress in the cultural tourism industry.

Technological innovation should shift from an "equipment-centered" to a "system-centered" approach. The number of projectors, resolution, and brightness do not independently determine experiential quality; what truly matters is the compatibility among equipment, software, content, and space. Technology selection should be based on site characteristics and narrative objectives rather than simply pursuing higher specifications. Real-time rendering, AI-generated content, computer vision, and spatial positioning are reshaping the production workflow of projection art. AI can assist in content generation and material organization, but such applications must be grounded in archival verification and artist-led creative processes.

4.2. Innovation in narrative and experience: From visual display to spatial narrative and interactive generation

Digital projection art provides visitors with diverse forms of experience through a wide range of expressive modes. Augmented reality (AR) projection overlays digital content onto real-world scenes, enabling visitors to experience the integration of virtual and real environments through AR devices [19]. For example, at historical sites, AR projection can reconstruct ancient architecture and everyday life scenes, making visitors feel as though they have traveled into the past [20]. Interactive projection uses sensing technologies to enable visitors to interact with projected content, thereby enhancing participation and enjoyment [15]. Immersive projection uses multi-surface projection and surround sound to create an all-encompassing immersive experience. Holographic projection employs optical technologies to present three-dimensional images and create the visual effect of objects suspended in space.

The key to innovation in expressive forms lies not in the number of formats but in whether different media form a logically coherent spatial narrative. Simply enlarging two-dimensional video onto a building façade does not automatically create immersive art. Genuine spatial narrative requires consideration of viewing height, walking routes, dwell time, and spatial transitions so that imagery corresponds to bodily movement. Immersion includes at least four dimensions: perception, space, narrative, and behavior. Only when light and sound, spatial position, story rhythm, and behavioral feedback operate synergistically can projection art move beyond "visual spectacle" toward a meaningful experience. Related research also indicates that immersive technologies themselves do not directly guarantee visitor satisfaction [21].

Content innovation is central to sustaining the vitality of digital projection art. Through animation and video, digital projection gives static historical and cultural content new vitality, reconstructing historical scenes and cultural stories to provide visitors with more vivid cultural understanding [22]. Interactivity is a core component of content innovation, as visitors can participate in content creation through interactive installations and experience the enjoyment of creativity [3]. In addition, digital projection art enables customized design, presenting specific visual content according to different themes and requirements [23]. Some cultural tourism projects exhibit a tendency toward "visual spectacle," using intense effects to create

momentary impact while lacking stable connections with local culture. Digital projection should therefore move from "visual narrative" toward "cultural narrative," transforming history, people, folk symbols, and spatial memories into logically connected narrative units.

Digital storytelling can enhance participation and the comprehensibility of cultural information through multimedia content, user choices, and spatial positioning [24]. Projection projects can establish different information nodes along visitors' movement routes, allowing them to gradually piece together cultural stories through spatial action and form a form of "spatialized narrative" characterized by bodily participation. Cultural heritage projects must also properly manage the relationship between "historical authenticity" and "artistic imagination": digital reconstruction should be grounded in historical evidence, while artistic expression should clearly indicate its creative status, thereby balancing credibility and artistic value.

Innovation in interaction mechanisms further incorporates visitor behavior into image generation. Interaction does not simply mean adding a "touch button"; rather, it should form a behavioral cycle of "action–system recognition–image response–visitor understanding." When movement, touch, or sound can alter the structure of projected imagery, meaning production genuinely shifts from unilateral creator control toward multi-actor co-construction. Visitors are not only recipients of cultural information but also participants in spatial experiences and agents of communication. Interactive design should also account for differences in age, physical ability, and digital literacy by providing clear prompts, moderate learning costs, and non-compulsory participation [25].

4.3. Innovation in evaluation and operation: From visitor volume to cultural experience and continuous feedback

Digital projection art requires an evaluative feedback system. Visitor volume, dwell time, and online exposure cannot adequately answer whether visitors have genuinely understood cultural content. Existing research has incorporated overall experience, cultural knowledge acquisition, negative experiences, and subsequent willingness to communicate into evaluation [16]. In response to the insufficient cultural anchoring, differences in interaction depth, and operational updating pressures identified in the cases in Section 2, this study proposes a four-dimensional evaluation framework of technology, experience, culture, and communication and translates it into an operational indicator system, as shown in the following table.

Table 2. Four-dimensional evaluation indicator system of "technology–experience–culture–communication"

Primary Dimension	Secondary Indicator	Observation Points	Evaluation Method
Technology	Spatial compatibility	Degree of fit between imagery and architectural/irregular structures; brightness and ambient-light adaptation; edge blending and color consistency	Technical testing
	System stability	Equipment failure rate; rendering latency; multi-projector synchronization accuracy; maintenance costs	Operational records
	Technology–site fit	Whether equipment selection is based on site conditions and narrative objectives	Expert assessment
Experience	Immersive perception	Degree of coordination among visual, auditory, and spatial perception	Visitor questionnaire
	Interactive participation	Whether actions/sounds can trigger image responses; clarity of prompts; whether participation is non-compulsory	Behavioral observation
	Bodily participation	Correspondence among walking routes, dwell time, and image rhythm	Path tracking

Primary Dimension	Secondary Indicator	Observation Points	Evaluation Method
Culture	Information accuracy	Whether historical information is supported by evidence; whether artistic imagination is clearly identified	Archival review
	Cultural understanding	Whether visitors can recount core cultural information and establish associations between symbols and meanings	Pre-/post-test questionnaire
	Memory retention	Degree of retention of cultural content one week/month after the experience	Delayed follow-up
Commu nication	Willingness to share	Whether visitors voluntarily photograph and post content; frequency of cultural elements in shared content	Social media analysis
	Willingness to revisit	Whether visitors are willing to revisit or recommend the project; whether content updates provide reasons for repeat visits	Visitor questionnaire
	Communication extension	Whether online content generates secondary creation and enters cultural discussion	Online content analysis

The application of this indicator system should follow several principles. First, technological indicators should function as "threshold conditions" rather than "target conditions": meeting technical requirements is a prerequisite for project viability but should not be the core criterion for judging project quality. Spatial compatibility and system stability are fundamental to project viability, but technical parameters should not be used as the central basis for evaluating project quality. Second, experiential indicators should distinguish between "immediate immersion" and "meaningful experience." Visual impact can generate an immediate sense of immersion, but only when combined with cultural understanding can it produce an experience with lasting mnemonic value. Third, cultural indicators should balance "credibility" and "comprehensibility." Historical projects require archival verification mechanisms, while artistic projects should clearly identify their creative status, avoiding the presentation of artistic imagination as historical fact. Fourth, communication indicators should focus on "cultural communication" rather than "traffic-based dissemination." Mere online exposure cannot be equated with cultural communication effectiveness; the quality and depth of cultural information in shared content should be analyzed. In practice, indicator weights can be adjusted according to project type: cultural heritage projects should assign greater weight to "cultural accuracy" and "cultural understanding"; theme parks may appropriately increase the weights of "immersive perception" and "willingness to share"; immersive art spaces should focus particularly on "interactive participation" and "bodily participation."

Digital projection art also exhibits a pronounced trend toward cross-media integration. When projection is combined with sound, lighting, stage machinery, mobile terminals, spatial positioning, and social media, the communication boundary of artworks extends from physical sites into networked spaces. The resulting chain of "on-site experience–mobile dissemination–online re-creation" means that the influence of cultural tourism projects is no longer confined to the period of visitors' physical presence. More importantly, cross-media integration should not be a simple accumulation of technologies; rather, different media should establish intertextual relationships around the same cultural theme, with each medium performing a distinct narrative function. From the perspective of public cultural value, digital projection also has the potential to connect local culture with public memory. If cultural tourism projects can incorporate the voices of local communities, intangible cultural heritage practitioners, and ordinary visitors, and transform personal memories into visual materials, projection works can move from "telling culture to visitors" toward "telling culture together with the public." Such participatory content production can strengthen cultural identity and reduce content homogenization in cultural tourism projects. The principles of sensing, information

interaction, and spatial services reflected in smart-space design research also provide useful perspectives for integrating projection art with smart cultural tourism spaces [19,26].

Through comprehensive innovation in technology, form, and content, digital projection art injects momentum into cultural tourism projects. Technologically, it integrates the virtual and the real to create distinctive experiences; formally, augmented reality, interactive projection, immersive projection, and holographic projection diversify experiential modes; and in terms of content, dynamic, interactive, and customized approaches enhance both project attractiveness and cultural value.

5. Conclusions and prospects

5.1. Conclusions

This study analyzes the application of digital projection art in cultural tourism within the context of new media art and draws three main conclusions. First, the media value of digital projection derives from the synergy of technology, space, and cultural content rather than from the performance of individual devices. When buildings, heritage sites, or exhibition spaces become interfaces for image generation, projection art acquires spatial narrative capabilities that distinguish it from conventional screen-based imagery. Second, the experiential value of digital projection depends on balancing immersion, interaction, and cultural understanding. Visual impact can attract attention, but only when combined with clear cultural cues, appropriate behavioral feedback, and continuous spatial narrative can it be transformed into a memorable cultural experience. Third, the industrial value of digital projection must be realized through continuous operation and impact evaluation. Projects should shift from one-off displays toward digital cultural spaces characterized by updatable content, feedback-driven experiences, and extensible communication. Accordingly, digital projection art should not be understood as a technological add-on to traditional cultural tourism projects, but as a composite medium for reorganizing the relationships among culture, space, media, and audiences.

5.2. Innovation pathway

Based on the above conclusions, this study proposes an innovation model of “cultural anchoring–spatial narrative–interactive generation–data feedback.” Cultural anchoring addresses “what to communicate”; spatial narrative addresses “where and how to communicate it”; interactive generation addresses “who participates”; and data feedback addresses “how to continuously optimize.” The four components form a closed loop, transforming digital projection from a one-off visual display into a continuously updated cultural experience system.

Specifically, the first component is cultural anchoring. Projects should first clarify cultural themes, historical evidence, and the boundaries of expression to avoid superficial treatment of cultural symbols. Historical projects should distinguish between “historical authenticity” and “artistic imagination”; intangible cultural heritage projects should respect the agency of practitioners and bearers; and local cultural projects should incorporate community memories and local knowledge. The second component is spatial narrative. Projects should organize narratives according to the spatial characteristics of buildings, heritage sites, exhibition halls, neighborhoods, or open landscapes. Imagery should not merely be attached to surfaces but should correspond to viewing height, walking routes, stopping points, and spatial transitions. The third component is interactive generation. Interaction should be designed at different levels, ranging from one-

way viewing and simple responses to route selection and co-creation, with non-compulsory participation options adapted to visitors' age, physical abilities, and digital literacy. The purpose of interaction is not to increase operational complexity but to enable visitors to understand cultural content through action. The fourth component is data feedback. Projects should establish four-dimensional evaluation indicators covering technology, experience, culture, and communication, focusing on spatial compatibility, system stability, immersive participation, information accuracy, understanding and retention, willingness to share, and willingness to revisit, and should use evaluation results to update content and optimize operations.

At the operational level, mechanisms for content copyright, data security, and audience privacy protection should also be established. Interactive systems may collect information about movement, voice, or even facial features, and project operators should clearly define the purposes and retention boundaries of such data. Digital reconstruction and AI-generated content also involve issues of material copyright and authorship attribution. Only by incorporating technological governance into project design can digital projection art develop a stable and sustainable industrial ecosystem.

The theoretical contribution of this study lies in examining digital projection within the media turn of new media art and emphasizing its composite attributes of "digital generation, spatial embedding, and relational interaction," thereby moving beyond the view of digital projection as merely a visual presentation tool. Methodologically, the study incorporates technology, space, experience, and cultural communication into a unified analytical framework and proposes a four-dimensional evaluation framework of technology, experience, culture, and communication together with an operational indicator system. In practice, the study proposes the pathway of "cultural anchoring–spatial narrative–interactive generation–data feedback," providing a reference for cultural tourism projects seeking to coordinate technological expression with cultural authenticity.

It should be noted that the above framework is primarily based on mechanism synthesis from existing research and typical cases and still requires validation through subsequent empirical studies. Digital projection art in cultural tourism projects currently faces risks of homogenization, technological dependence, and compromised cultural authenticity. Similar visual templates can produce "a thousand scenes with one face"; equipment maintenance and content updating require sustained investment; and excessive entertainment-oriented treatment of historical content may leave visitors with little more than a visual impression. Future development should therefore shift from "adding technology" to "adding cultural value." Subsequent research could establish a more refined evaluation indicator system through cross-case comparisons and conduct stratified analyses based on differences in experiences among visitor groups, thereby further testing the mechanisms through which digital projection influences cultural cognition, emotional identification, and tourism behavior. Future studies should also examine the marginal effects of different combinations of media to avoid cognitive overload caused by excessive technological layering.

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