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Academic Article

Cultural Communication and Digital Design of Fujian Hakka Tulou: Analysis on Shen Yuan Tulou Residents' Questionnaire Feedback

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Abstract

Fujian Tulou, as a significant component of Hakka culture, possesses a unique historical background and architectural style. However, with the development of tourism and the advancement of modernization, Tulou culture faces challenges in both preservation and development. To balance the demands of cultural preservation and tourism development, this study takes Shen Yuan Tulou, a typical circular Hakka Tulou with an inner corridor, as a case study to explore how digital technology can innovate cultural experiences, particularly in resource-limited regions. Through qualitative research methods, including in-depth interviews and questionnaire surveys, feedback from community residents on the digital interactive design of Shen Yuan Lou was collected, along with their perceptions and evaluations of the cultural experience.

The design of the questionnaire survey analyzes Fujian Tulou residents' cultural awareness, living experiences, and acceptance of protection technologies to understand their attitudes and needs regarding the future development of Tulou. Survey results indicate that most residents have a high level of awareness about the history and culture of Tulou and are enthusiastic about introducing Tulou's traditional culture to visitors. The majority of residents are open to Tulou becoming a tourist attraction but hope that tourism development will not impact their daily lives. Most residents accept the application of new technologies, believing that these digital technologies can effectively enhance cultural communication and improve visitor experiences.

Based on the feedback from residents, a digital technology and cultural heritage interactive experience plan is designed, incorporating new modes of cultural heritage protection and dissemination, such as virtual reality and interactive experiences. This plan emphasizes the importance of visitor experience and community involvement. It is recommended that future preservation and development of Tulou focus not only on the application of technology but also on the actual needs and quality of life of residents, aiming to achieve a balance between cultural heritage preservation and sustainable development. The research results provide empirical support and strategic recommendations for the digital presentation and dissemination of Fujian Tulou and similar cultural heritage sites, holding significant importance for promoting the sustainable development of cultural heritage. Future research will focus on optimizing interactive design and exploring the application of digital technology in broader cultural communication and preservation through user feedback.

Keywords: Fujian Hakka Tulou, Cultural Communication, Digital Design, Questionnaire Feedback Analysis

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Introduction

Cultural overview of Fujian Tulou

Fujian Tulou, a traditional residential type created within the unique cultural context of the Hakka people, serves as a microcosm of Hakka history and development, vividly reflecting the rich cultural connotations of the Hakka. The distinctive architectural form and spatial layout of Fujian Tulou vividly express the strong family cohesion and sense of identity inherent in Hakka spirit. The communal living style has become the primary choice for architectural functionality, while defensive and exclusive characteristics have become fundamental features of the building form, ultimately creating the unique residential form of Fujian Tulou, which integrates family, ancestral hall, and fortress.

Shen Yuan Tulou (Figure 1), as a case study, is located in Jingtou, Guzhu Village, Guzhu Township. It is a typical circular Hakka Tulou with an inner corridor, with a diameter of 81 meters, making it the largest Tulou measured to date. It has four concentric rings, with the outer ring being four stories high, featuring 54 bays and formerly accommodating over 90 households and more than 500 people. Its architectural form, cultural connotations, and aspects of preservation and development make it a representative subject for research.

Figure 1 Aerial Photo of Shen Yuan Tulou
source: JieRu, 2024

Relationship between resident satisfaction and cultural communication

The development of Fujian Tulou into tourist attractions has driven rural revitalization and promoted the protection and promotion of cultural heritage. However, it also faces issues such as impacts on residents' quality of life, ecological damage, environmental pollution, and cultural commercialization. Tourist sites are not only places for sightseeing but also the living environment for residents. Sustainable tourism should reflect the authentic ecological and lifestyle characteristics of the local community.

Therefore, protecting cultural heritage should not solely rely on policies issued by government departments; it also requires extensive involvement from local residents. Resident participation is crucial for preserving cultural heritage, enhancing tourism quality, and achieving harmonious development between the environment and the economy. Consequently, by combining residents' cultural awareness, living experiences, acceptance of protection technologies, and development needs, a questionnaire is designed to explore the level of acceptance of digital design. This approach aims to tailor visitor experiences to user needs, enhancing visitors' understanding and emotional connection to Tulou culture

Role of digital design in cultural communication

Digital technologies, particularly VR (Virtual Reality) and interactive experiences, can economically and effectively present historical living scenes in ancient buildings, offering immersive visual experiences. Compared to traditional text and video formats, digital technology can comprehensively showcase the scenes and details of ancient buildings, enrich tourism content, and attract more visitors. Although digital technology cannot entirely replace the emotional experience of traditional tourism, it can complement the shortcomings of traditional projects, increase the fun and enjoyment of tourism, and extend visitors' stay. This allows them to gain a deeper understanding of the customs, development history, and cultural heritage of Shen Yuan Tulou.

Objective

1. Explore the Uniqueness of Fujian Tulou Culture and Its Protection and Dissemination Value in Modern Society.
2. Analyze the Relationship Between Resident Satisfaction and Digital Cultural Dissemination, Revealing the Impact of Increased Resident Participation on Cultural Heritage.
3. Evaluate the Effectiveness of Digital Design in Tulou Culture Dissemination, Propose a Digital Interactive Experience Plan for Fujian Tulou

Method: Literature review

McLuhan posits that media are extensions of human beings, and he views architecture as a medium. Residential buildings, as living spaces, are extensions of the human body's temperature control mechanism, functioning as collective skin or clothing (McLuhan, 2000).

Fujian Hakka Tulou research

Fujian Tulou are predominantly located in Yongding, Nanjing, and Hua'an. These multi-story, large-scale residential structures were designed to resist external invasions and accommodate extended families, employing rammed earth walls and wooden beams for structural support. There are over 28,000 Tulou in existence, with more than 23,000 located in Yongding, Fujian. Currently, over 3,000 Tulou in Fujian are officially listed on the World Heritage List. Due to the predominance of Hakka residents, these structures are commonly referred to as "Hakka Tulou" (Lin & Li, 2023).

The Hakka Tulou in Yongding County, Fujian, were among the first to attract scholarly attention and research. Early works such as "Fujian Yongding Hakka Residential Buildings" have discussed the forms and characteristics of Yongding Tulou (Zhang, 1957). The book "Shizhong Tulou Measured Atlas," authored by Professor Lu Bingjie and his students, provides comprehensive field surveys of Tulou in Shizhong Town, Yongding County, and serves as a valuable source of detailed data (Lu, 2011). Huang Hanmin's research and publications on Fujian Tulou are notably thorough. His edited volume, "Fujian Tulou: A Treasure of Chinese Traditional Residential Architecture," extensively discusses the origins, forms, spatial composition, and future directions for the development and preservation of Tulou (Huang & Chen, 2012). The work "Tulou and Chinese Traditional Culture" explores the characteristics of Hakka culture and its relation to Tulou, providing arguments and evidence on aspects such as Tulou classification, decorative arts, and spatial layout (Lin, 1995).

International research on Tulou includes Professor Keijiro Mogi of Tokyo University of the Arts, who discussed field surveys in his book "Studies on Chinese Residential Buildings: Exploration of Residential Spaces in Southeast China" (Keijiro, 1996). Peruvian architect Silvia conducted two field studies of Fujian Tulou in the 1990s and designed and built a school in Peru with a Tulou-inspired structural form, validating the excellent seismic resistance of Tulou structures. While this international perspective offers unique

reference value, it lacks a comprehensive understanding of the regional traditions, history, and cultural context of Tulou.

The role of resident satisfaction in cultural dissemination

The concept of community involvement began to gain recognition internationally starting in 1985, notably discussed by Murphy in his article "Tourism: A Community Approach" (Murphy, 1985). Resident satisfaction has since been enriched and expanded to encompass various dimensions, including value systems, interpersonal relationships within regions, basic living needs, and higher-level spiritual pursuits (Scheyvens, 1999). In 2002, Ko Dongwan and William Stewart further emphasized that for scientifically planning tourism development, incorporating the satisfaction of local residents is crucial, as it is a key component of comprehensive planning (Ko & Stewart, 2002).

Domestic scholars have similarly approached the study of community involvement in tourism development from the perspective of "community participation." They discuss the importance of community engagement from both internal and external empowerment angles (Zuo & Bao, 2008). Ensuring the authenticity of heritage site tourism and enhancing community residents' sense of ownership are essential for protecting community interests, especially those of minority communities, and reducing obstacles to community participation in tourism development. Wang Yajuan asserts that the perspectives of various levels of governance and government functions determine the effectiveness of community participation in tourism development, making the improvement of tourism community livelihoods a significant objective (Wang, 2012). Zhang Ruiying's research report highlights that tourism development, social development, and local residents involve a multi-stakeholder and diversified cooperation mechanism (Zhang, 2018)

The application of digital technology in cultural heritage preservation

Internationally, research on tangible cultural heritage has been advanced. Many leading equipment and software teams have developed programs and plugins specifically for the virtual representation of tangible cultural heritage. International conferences have also focused on the dissemination of tangible cultural heritage, such as the Virtual Systems and Multimedia Conference (VSMM) (Li, 2004) and the Electronic Imaging and the Visual Arts (EVA) conferences held from 2002 to 2008, which included specialized sessions on cultural heritage (Callieri et al., 2006).

Domestically, China has achieved notable progress in the digital preservation of tangible cultural heritage, garnering international attention. For example, Zhejiang University’s CAD & CG National Key Laboratory's "Digital Dunhuang" project. Digital preservation cases, such as those at the Jingjiang Wangling tombs and the Yungang Grottoes, demonstrate that digital technology has developed into a relatively complete system (Wang, 2019). Digital technologies for ancient architectural sites and museum collections have further advanced by visualizing information and establishing information systems that facilitate comprehensive management of the condition of ancient buildings (Ran, 2021). The establishment of 3D virtual technology models has enabled informatized management of cultural heritage buildings, significantly enhancing preservation efforts. Compared to traditional methods, 3D virtual technology offers distinct advantages in the protection of ancient architecture.

The medium of Tulou culture has shifted from architectural to digital media, reaching a broader audience and transitioning towards a "spatial orientation" (Lin & Ma, 2023). Digital design applications in Tulou include cultural elements showcased through works such as the "Hakka Tulou Trilogy," comprising the symphonic music piece "Echoes of the Tulou," the large-scale original musical "Spirit of the Tulou," the opera "Tulou," and the animated film "Big Fish & Begonia." However, challenges remain in the depth of cultural content exploration and the integration of dissemination resources (Lin & Ma, 2023).

Survey and data analysis

Based on a review of existing literature and research by scholars both domestically and internationally, field surveys were conducted locally, focusing on the surrounding environment of Shen Yuan Tulou, interviews with residents, and analysis of historical clan records. A survey was designed to assess the residents' awareness of Tulou culture, their satisfaction with living conditions, acceptance of preservation technologies, and attitudes towards development. This led to the creation of a feedback model for residents of Fujian Tulou.

Data collection represents the preliminary stage of the research, while the core of the study lies in the screening, integration, organization, and analysis of the data. The validity of the model is confirmed through the application of various mathematical analysis methods to process the data. Through three months of field research and visits, we have collected 70 valid data entries. By employing a cross-analysis method, we have interpreted the differences and commonalities among survey respondents in terms of their involvement in the protection of Tulou, satisfaction with living conditions, and attitudes towards the application of new technologies, based on two conditions: "age" and "duration of residence." Age-Related Influence on Participation, Satisfaction, and Technology Acceptance (Table 1).

Different age groups exhibit significant variations in their involvement in Tulou preservation, satisfaction with living conditions, and attitudes towards new technology. The middle-aged group (31-45 years) shows the highest willingness to participate in Tulou protection and maintenance, indicating a strong commitment to cultural heritage preservation. In terms of living satisfaction, the 18-30 age group has higher expectations for living conditions and therefore reports lower satisfaction. However, satisfaction with living conditions improves with age, with individuals over 46 years old demonstrating higher acceptance of current living conditions. Regarding new technology, younger and middle-aged individuals (18-45 years) show higher acceptance of new technologies (such as VR/AR) and are more willing to engage in cultural heritage preservation involving these technologies. In contrast, older individuals exhibit lower acceptance levels, potentially due to a lack of familiarity with or barriers to using new technologies.

Table 1 Cross-analysis results chart- age

Question	Answers	Age					Sum
		Under 18	18-30	31-45	46-60	60 or more	
Will you participate in the preservation and maintenance of Shen Yuan Lou?	No	0(0%)	10(76.923%)	2(15.385%)	0(0%)	1(7.692%)	13
	Yes	1(1.754%)	23(40.351%)	20(35.088%)	12(21.053%)	1(1.754%)	57
Sum		1	33	22	12	2	70
Do your current living conditions (e.g., space, facilities) meet your daily needs?	Very satisfied	0(0%)	13(65%)	5(25%)	2(10%)	0(0%)	20
	Basically satisfied	1(4%)	8(32%)	10(40%)	5(20%)	1(4%)	25
	Dissatisfied	0(0%)	4(66.667%)	2(33.333%)	0(0%)	0(0%)	6
	Very dissatisfied	0(0%)	8(42.105%)	5(26.316%)	5(26.316%)	1(5.263%)	19
Sum		1	33	22	12	2	70
Are you open to the use of new technologies (such as digital tools: VR/AR, etc.) for the preservation and presentation of the Tulou?	No	0(0%)	7(77.778%)	1(11.111%)	1(11.111%)	0(0%)	9
	Yes	1(1.639%)	26(42.623%)	21(34.426%)	11(18.033%)	2(3.279%)	61
Sum		1	33	22	12	2	70

Influence of length of residence on protection participation, satisfaction, and technology acceptance are shown in Table 2.

Analyzing the data from the perspective of "length of residence," it is evident that the duration of residence significantly affects Tulou residents' willingness to participate in protection and maintenance, their satisfaction with living conditions, and their acceptance of new technology. Residents who have lived in Tulou for more than 10 years show the highest willingness to participate in protection and maintenance, accounting for 42.105%. This suggests that long-term residents, due to emotional ties, are more inclined to engage in preservation efforts. Conversely, residents who have lived in Tulou for less than one year have the lowest

participation rate, at only 10.526%, which may be attributed to a lack of belonging and the short duration of residence, leading to lower motivation for protection.

Regarding living satisfaction, while there is a correlation between length of residence and satisfaction, length of residence is not the sole determinant. Long-term residents are present in both the "satisfied" and "dissatisfied" groups, indicating that satisfaction is influenced by multiple factors including personal expectations and actual needs.

In terms of technology acceptance, residents across all lengths of residence show high levels of support, with over 87% indicating acceptance. This demonstrates that new technologies have broad appeal across different resident groups. These findings provide empirical support for developing more effective Tulou protection policies, improving living conditions, and promoting the application of new technologies.

Table 2 Cross-analysis results chart - duration of residence

Question	Answers	Duration of Residence				Sum
		Less than 1 year	1-5 years	5-10 years	More than 10 years	
Will you participate in the preservation and maintenance of Shen Yuan Lou?	No	3(23.077%)	5(38.462%)	2(15.385%)	3(23.077%)	13
	Yes	6(10.526%)	18(31.579%)	9(15.789%)	24(42.105%)	57
Sum		9	23	11	27	70
Do your current living conditions (e.g., space, facilities) meet your daily needs?	Very satisfied	4(20%)	6(30%)	6(30%)	4(20%)	20
	Basically satisfied	2(8%)	8(32%)	2(8%)	13(52%)	25
	Dissatisfied	1(16.667%)	4(66.667%)	0(0%)	1(16.667%)	6
	Very dissatisfied	2(10.526%)	5(26.316%)	3(15.789%)	9(47.368%)	19
Sum		9	23	11	27	70
Are you open to the use of new technologies (such as digital tools: VR/AR, etc.) for the preservation and presentation of the Tulou?	No	3(33.333%)	4(44.444%)	0(0%)	2(22.222%)	9
	Yes	6(9.836%)	19(31.148%)	11(18.033%)	25(40.984%)	61
Sum		9	23	11	27	70

Residents exhibit significant differences in their preferences for tour development methods for Tulou (Table 3). The analysis reveals that 48.571% of respondents prefer an "open visitor access (while still residing in Tulou)" model. This preference indicates that the majority of residents favor a model allowing tourists to visit while retaining their original living conditions, emphasizing a coexistence of daily life and tourism. In contrast, 34.286% of respondents support the establishment of "cultural exhibition spaces within Tulou (without affecting residence)." This choice acknowledges the importance of cultural transmission and display while ensuring that daily life is not disrupted. Only 17.143% of respondents favor a "closed scenic area development (with residents moving out of Tulou)." This indicates that a relatively small proportion of residents are willing to abandon the residential function of Tulou in favor of a fully developed closed scenic area. Cumulative percentages show that over 80% of respondents prefer tourism development in Tulou with either no change or minimal adjustment to their living conditions. This reflects residents' deep appreciation for their traditional cultural environment and their recognition of Tulou's potential as a tourism resource.

Table 3 Frequency analysis results table

Question	Answers	Frequency	Percent(%)
What type of tour experience would you prefer for the Tulou?	Closed-Style Tourist Development (Moving out of the Tulou)	12	17.143
	Open-Style Visitor Access (Remaining in the Tulou)	34	48.571
	Creating Cultural Display Spaces within the Tulou (Without Affecting Residence)	24	34.286
Sum		70	100.000

Among the display methods (Table 4), video (documentaries) is the most recognized, with the highest response rate of 20.707% and the leading popularity rate of 58.571%. This indicates that most respondents consider video to be the most effective method for protecting and promoting Shen Yuan Tulou. Following this are images (photo panels) and 3D projections (stereoscopic videos), each with a response rate of 17.677%, showing that these methods are also widely acknowledged. In contrast, virtual reality (VR devices for experiencing 3D virtual spaces) has a relatively low response rate of 12.626%, which may be due to the limitations of technology adoption and the cost of experiences. Overall, future strategies should integrate multimedia methods such as video, images, and 3D projections, while also exploring the potential of interactive installations and virtual reality to create a more comprehensive dissemination system.

Table 4 Multiple response frequency analysis

Question	Answers	Frequency	Response Rate (%)	Penetration Rate (%)
Which measures do you think would better protect and promote the Tulou?	Images (Photographic Panels)	35	17.667%	50%
	Videos (Documentaries)	41	20.707%	58.571%
	3D Projection (Stereoscopic Video)	35	17.677%	50%
	Interactive Devices (Touch-Based Interaction)	34	17.172%	48.571%
	Virtual Reality (VR Space)	25	12.626%	35.714%
	Guided Experiences (Leading Visitor Interactions)	28	14.141%	40%
Sum		198	100%	282.857%

Result/Finding

Designing interactive experiences and digital display solutions based on data analysis results

Shen Yuan Tulou, as a representative architectural structure of Fujian Tulou, carries rich historical and cultural connotations as well as a unique architectural style. To protect and promote the cultural heritage of Shen Yuan Tulou while meeting the diverse needs of both residents and visitors, it is proposed to establish specific opening times or designated areas. This approach will protect residents' privacy while allowing visitors to experience the living atmosphere of the Tulou. By utilizing advanced digital technology, the historical appearance and architectural details of Shen Yuan Tulou can be authentically restored, enhancing the visitor experience. Through diverse interactive methods, visitors will become active participants in the cultural experience, thus improving the effectiveness of cultural dissemination. The plan combines digital technology and interactive experience design to achieve an organic integration of cultural preservation and modern presentation.

Strategy plan development

Initial stages involved gathering data, reviewing literature, and analyzing to determine the architectural form and artistic style of Shen Yuan Tulou. Additionally, data was organized and summarized from interviews and surveys conducted with Shen Yuan Tulou residents.

Digital 3D Mapping: Utilizing drone-captured data of Shen Yuan Tulou's exterior and surrounding environment, a 3D model of the building was created, meticulously restoring the architectural structure, historical traces, and material details of the Tulou. The model is imported into the Unreal Engine 4 for processing of lighting, materials, and volumes, achieving a realistic visual effect that showcases the historical essence of Shen Yuan Tulou (Figure 2).

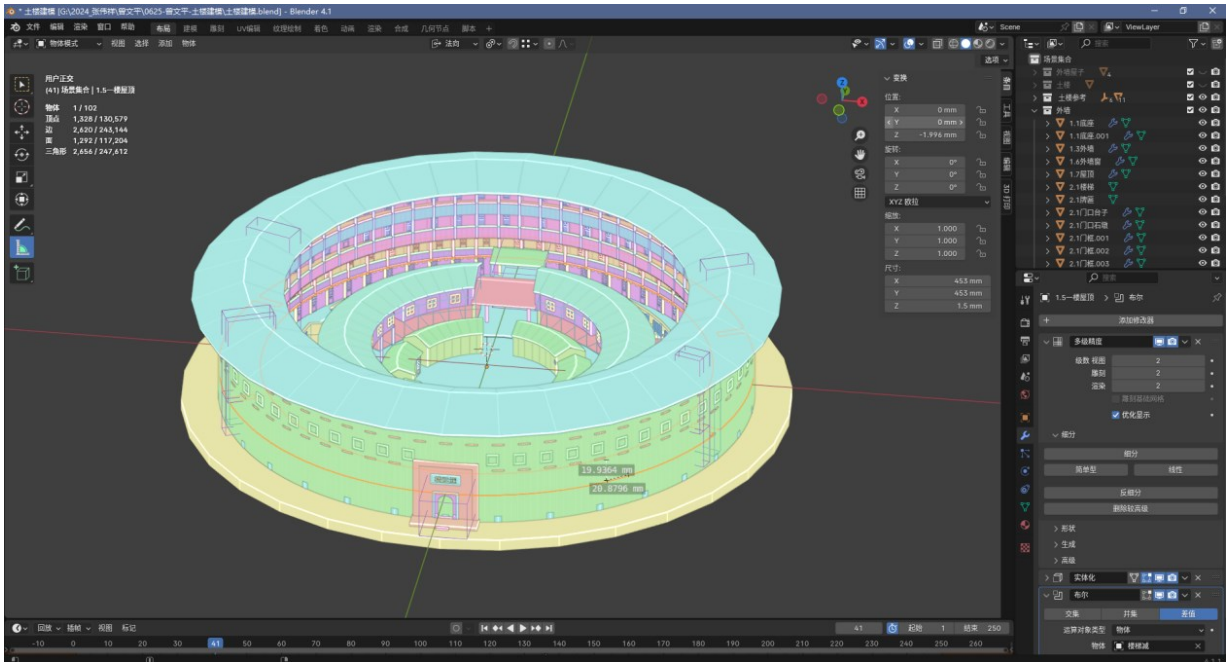

Figure 2 3D Modelling Interface of Shen Yuan Tulou
source: JieRu, 2024

Interactive Tour System Development: Using VR technology, a virtual tour of Shen Yuan Tulou is developed, allowing visitors to explore every corner of the Tulou in a virtual space and gain insight into its historical and cultural background.

Interactive Experience Design: To protect residents' privacy, specific visiting times and areas are established. Open areas can include public spaces within the Tulou, such as halls and corridors, where visitors can experience traditional living scenes. AR interactive devices are installed in the open areas; visitors can scan designated zones with mobile devices to view related historical stories or architectural information and engage in simple interactive experiences. Some Shen Yuan Tulou residents will act as guides, sharing the history and life stories of the Tulou with visitors, thereby enhancing interactivity and authenticity while increasing resident engagement.

Discussion

Current issues and improvement directions

Currently, the development of Fujian Tulou scenic areas, although somewhat improving residents' living conditions following government consolidation, still suffers from insufficient resident involvement in key aspects such as planning, management, and development. As residents are the direct contacts for tourists, they can help address tourist needs and enhance the visitor experience. Thus, increasing resident participation is crucial.

Improvement directions

To enhance the involvement of residents in the development of scenic areas, it is crucial to establish mechanisms that give them a voice in planning and management. This can be achieved by setting up resident-led tour and cultural display projects, allowing residents to participate directly in the tourism economy. Ensuring that benefits are shared fairly and distribution mechanisms are transparent is essential for

guaranteeing that resident's benefit from tourism development. It is equally important to respect the residents' way of life and culture, avoiding negative impacts on their daily lives due to excessive commercialization. Combining digital technology with interactive experience design can foster the development of cultural experience projects co-created by both tourists and residents. Additionally, building trust between residents, the government, and developers is vital. Providing training to improve residents' skills and establishing a continuous feedback mechanism will help optimize development plans. By implementing these measures, it is possible to not only improve residents' living conditions but also to promote the sustainable development of scenic areas and enhance their attractiveness.

Current applications of digital technology in cultural heritage protection

Digital technology in cultural heritage protection is currently dominated by virtual reality, primarily led by computer experts focusing on "faithful recording" of architectural heritage's appearance and details. However, this approach often overlooks the artistic aspects of material cultural heritage, treating it as an engineering project rather than an art form. Although artists and designers possess high artistic and aesthetic qualities, they generally lack programming skills and thus do not directly participate in the digitization process. This disconnect between technology and art results in a lack of artistic quality in the digital representation of architectural heritage, with most research still focused on the simulation of ancient buildings.

Suggestion

Firstly, strengthen the education on Tulou culture by regularly hosting cultural lectures, workshops, and exhibitions. This will enhance residents' understanding of the history, architectural style, and cultural value of Tulou, as well as organize activities for the inheritance of traditional crafts and customs to increase residents' sense of identity and awareness of Tulou culture.

Secondly, introduce modern facilities, such as environmentally friendly sanitation and smart home systems, without disrupting the original living environment. Improve residents' living conditions by managing these facilities within designated areas or time slots to avoid interfering with residents' daily lives while meeting the needs of tourists.

Thirdly, use digital means for the protection and dissemination of Tulou culture. Create interactive experience platforms using virtual reality (VR) and augmented reality (AR) technologies, and establish digital resource libraries, such as virtual tours, documentaries, and cultural stories, to expand the influence of Tulou culture.

Fourthly, explore tourism development models suited to Tulou's characteristics. Implement an open visitor access model and cultural experience projects that allow tourists to visit Tulou without disturbing residents' lives. Enhance tourist engagement through interactive projects like traditional craft experiences and cultural lectures.

Finally, recommend conducting pilot projects during implementation to assess the actual impact of measures on residents' lives and tourist experiences. Establish continuous monitoring and feedback mechanisms, and conduct in-depth research to provide data support and theoretical foundations for subsequent policy formulation and project implementation. Through these measures, it is possible to improve residents' living conditions while protecting Tulou culture, achieving a harmonious coexistence of culture and tourism.

Conclusion

This study aims to explore the awareness of Fujian Tulou residents regarding Tulou culture, their living experiences, and their attitudes toward Tulou protection and development. The data from the comprehensive questionnaire survey reveal that most residents have a certain level of understanding about the history and culture of Tulou and are willing to introduce the historical background, architectural style, and traditional way of life of Tulou to visitors. Some residents actively participate in traditional cultural activities, such as festival celebrations and ancestral rites. Regarding living conditions, resident satisfaction varies; some wish to introduce modern facilities such as bathrooms, air conditioning, and internet, while residents who have lived in Tulou for a longer time are relatively more satisfied with their living conditions. Residents have an open attitude toward Tulou becoming a tourist attraction but prefer that tourism development does not affect their daily life. Most residents accept new technologies, such as VR/AR, for Tulou protection and display,

believing that these can enhance cultural dissemination and improve visitor experiences. At the same time, residents identify reasons for Tulou not becoming a tourist attraction, including its remote location and the high development costs, and they hope for support in the form of government and private funding, heritage protection policies, and traditional building restoration techniques to promote Tulou protection and promotion. These findings provide valuable references for the future protection and development of Tulou, highlighting the comprehensive importance of cultural heritage, living condition improvements, and technology application.

In reflecting on the application of digital technology, this study recognizes its potential to revolutionize the way cultural heritage sites like Fujian Tulou are experienced and understood. The integration of digital technology not only aids in the preservation and dissemination of cultural heritage but also offers new avenues for community engagement and economic development. Future research directions could include optimizing user experience through personalized digital interactions and assessing the long-term impact of digital technology on the cultural and economic sustainability of heritage sites. By exploring these areas, we can better understand how digital technology can be harnessed to balance conservation efforts with the evolving needs and expectations of both residents and visitors.

In future development prospects, it is suggested to approach from a co-creation perspective, focusing not only on the protection of Tulou buildings themselves but also on promoting the cultural revival of Tulou by increasing public awareness. Subsequent research should emphasize exploring how to balance protection and tourism development, and fully utilize digital technology to strengthen cultural dissemination and resident participation, thereby achieving the sustainable development of Tulou culture.

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