

# Digital Preservation of Zhujiayu Village's Cultural Landscape: A New Approach to Sustainable Development

Wang Tongyun<sup>1,2</sup>, Izham Ghani<sup>1\*</sup>, Suriati Ahmad<sup>1</sup>, Norhafizah Abdul Rahman<sup>1</sup>,  
Zhou Shiwan<sup>3</sup>, Hairunkamal Wahid<sup>4</sup>

<sup>1</sup>Department of Built Environment Studies and Technology, College of Built Environment, Universiti Teknologi MARA, Perak Branch, 32610 Seri Iskandar, Perak, Malaysia

<sup>2</sup>School of Fine Arts and Design, Heze University, Heze, 274000 Shandong, China

<sup>3</sup>Jiangxi University of Software Professional Technology, Nanchang, 330000 Jiangxi Province, China

<sup>4</sup>SKA Landscape Architects, 11-2F, Jalan Boling Padang G 13/G, Seksyen 13 40100 Shah Alam, Selangor, Malaysia

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## ABSTRACT

This paper examines Zhujiayu Village in China, focusing on its distinctive natural environment, traditional architecture, and intangible cultural heritage. By integrating digital preservation with sustainable development, the study aims to safeguard and perpetuate the unique cultural landscape of Zhujiayu Village. At the core of this study is the application of digital technology in the conservation of cultural landscapes by employing technologies such as 3D scanning, geographic information systems (GIS), and virtual reality (VR) to create a comprehensive digital archive of the village's traditional architecture, cultural landscapes, and intangible heritage. Through the creation of digital archives, a detailed record will be provided for the restoration projects of future buildings while raising public awareness of the protection of buildings and intangible cultural heritage. Through the construction of digital scenes, virtual tourism is promoted so that more people can understand the culture of Zhujiayu Village and reduce the wear and tear of intangible cultural heritage. The study also explores the challenges and opportunities of digital protection technologies, highlighting the need for collaborative efforts between government agencies, local communities, and tourism management organisations. In conclusion, the Zhujiayu Village Cultural Landscape digital conservation study model not only provides a pioneering approach to

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<sup>1\*</sup> Corresponding author. E-mail address: [izham025@uitm.edu.my](mailto:izham025@uitm.edu.my)  
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heritage conservation but also provides valuable insights and a framework that can be adapted and applied to other similar rural cultural heritage conservation in China, marking an important step towards the sustainable development of heritage conservation.

## INTRODUCTION

In the field of cultural heritage protection, the integration of historical heritage and modern technology has created an innovative protection model to ensure that cultural heritage can still withstand the test of time. The site selected for this study is Zhujiayu Village in China, which has 600 years of traditional architecture and a long history of cultural heritage. It is a very representative village rich in traditional Chinese culture. This study aims to identify effective measures to protect this rich cultural heritage, ensuring its preservation as time progresses.



Fig. 1. Geographical location map of Zhujiayu village

Source: Authors (2023)

The architectural complex of Zhujiayu Village, with its outstanding integrity and historic architectural features, shows us the originality and exquisite craftsmanship of traditional Chinese architecture, which not only bears witness to the changes in history but also proves the powerful inheritance of culture. However, under the influence of the modernisation process, the deterioration of the environment is gradually increasing, and the similarity of the construction and cultural protection of various villages and the lack of unique characteristics pose a severe threat to the protection of the cultural heritage of Zhujiayu Village. The rapid urbanisation process, the deterioration of the environment, and the homogenisation of culture all pose a serious threat to the protection of Zhujiayu Village's cultural heritage. This not only threatens the village's material heritage but also erodes the spiritual heritage that sustains the village's unique cultural identity. Therefore, this study aims to explore and formulate effective conservation strategies to ensure that this precious cultural heritage of Zhujiayu Village can be adequately protected in the modernisation process and continue to serve as an essential resource for studying traditional Chinese rural life and culture. Through the comprehensive application of modern scientific and technological means and conventional protection methods, we hope to provide useful reference and inspiration for the protection of Zhujiayu Village and even more similar cultural heritage. At the same time, we call on all sectors of society to pay more attention to and support the protection of cultural heritage and jointly safeguard our precious cultural heritage so that it will continue to shine in the new era.

In recent years, China has paid more and more attention to protecting cultural heritage, which is not only the restoration of some old buildings but also the preservation of traditional customs, social activities, and knowledge. Doing so is essential to protect culturally important places like Zhujiayu Village, ensuring they retain their original character and value even as they change. Now, the technology of digital conservation can help us better protect our cultural heritage. The technology uses many advanced tools, such as 3D scanning, geographic information systems (GIS), and virtual reality (VR), to accurately reproduce digital versions of cultural sites. Not only does this make it easier to document and manage these

sites, but it also makes these cultural heritage sites accessible to more people through education, research, and tourism, increasing their sense of participation and conservation. This article focuses on how digital conservation technology can play a role in preserving cultural heritage, such as Zhujiayu Village, and seeks to identify the challenges and opportunities presented by digital technology and evaluate its effect on maintaining material and intangible heritage. At the same time, we will analyse the role of this technology in global cultural heritage protection and propose a protection model suitable for other places, hoping to bring some valuable inspiration to the cultural heritage protection work in China's traditional villages.



Fig. 2. Zhujiayu Aerial Photo

Source: Authors (2023)



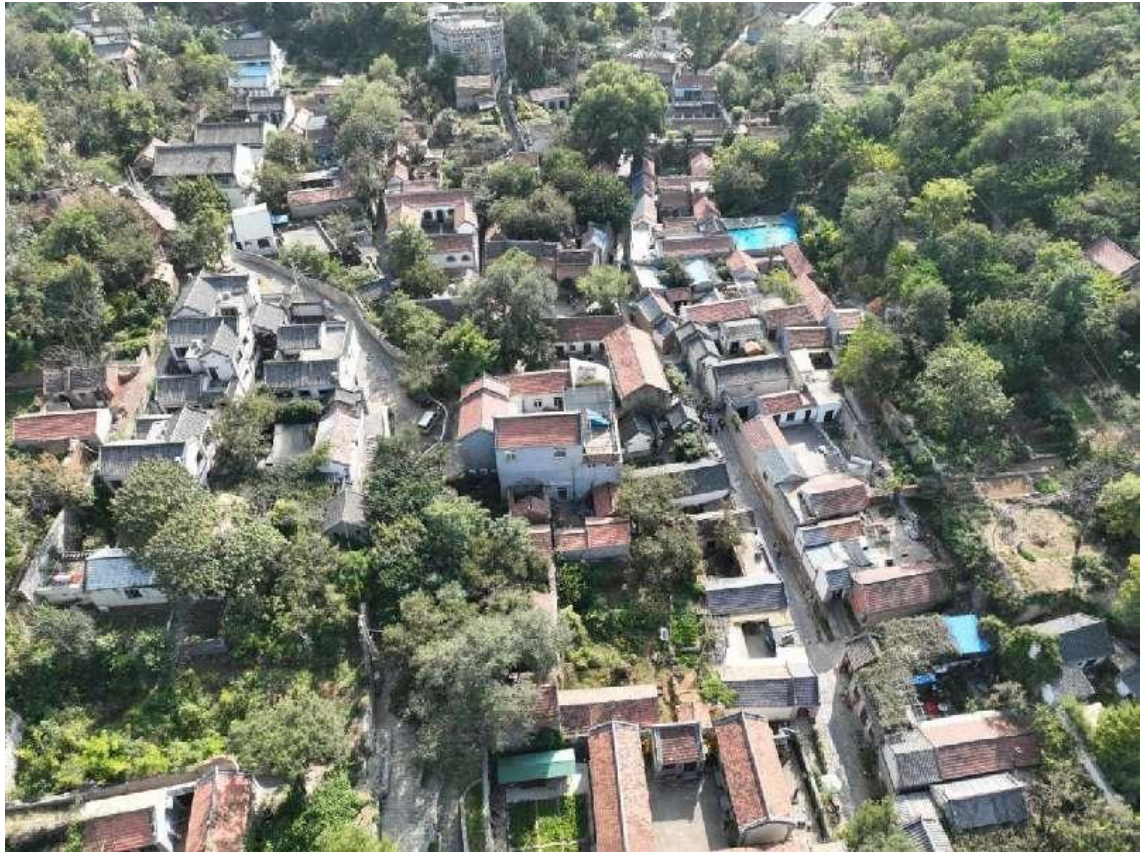


Fig. 3. Local layout of Zhujiayu Village

Source: Authors (2023)

## LITERATURE REVIEW

### Digital Preservation in Cultural Heritage

In recent years, many digital technologies have been used to protect cultural heritage, buildings, traditional customs, folk art, and other cultures. This review article combines recent research on modern technology to help us better preserve and pass on our cultural heritage..

Perera (2023) emphasises the importance of digital preservation of libraries, archives, and museums and the indispensability of digital preservation of peoples' beliefs' traditional cultural heritage (TCH). However, in terms of protection, the cost of funds, the limitation of technical level, and the outdated equipment also pose new challenges to protecting cultural heritage. Pandey and Kumar (2020) conducted an in-depth analysis of the problems encountered in digital cultural heritage resources and conservation, such as insufficient funding, lack of national policy support, and insufficient technical facilities.

Učakar et al. (2022) conducted an in-depth analysis of wooden sculptures using photogrammetry and 3D modeling techniques to create 3D images, enabling them to achieve long-term protection of cultural heritage using digital technology. Their research confirms that the original structural features of objects can be displayed in more detail through 3D models and graphic documentation, and the accessibility and interactivity of cultural heritage can be improved through interactive technology so that its cultural connotation can be displayed to people in more detail.

Based on the above findings, the authors find that digital conservation is the most effective measure for protecting cultural heritage. Although there are many financial and technical constraints, the field of digital conservation is actively seeking the economic, technical, and facility challenges involved in combining innovative technology and traditional maintenance strategies to solve the problem of sustainability. In addition, a more comprehensive cultural heritage protection framework can be sought through interdisciplinary cooperation so that cultural heritage can be better protected to realise social values' needs.

### **Cultural Landscape Conservation**

In the protection of heritage, the protection of cultural landscape is an important part that cannot be ignored, not only the protection of heritage values but also the participation of community members. Sari and Munandar (2020) studied the core protected areas and buffer zones of Indigenous villages in Urug, Indonesia. They proposed a comprehensive conservation planning strategy to maintain and strengthen the uniqueness of these cultural landscapes through careful assessment of key elements such as land use, spatial layout, and cultural traditions. Make sure it's passed on.

Rössler & Lin (2018) discussed in depth the positive role of regionalised landscape conservation in Asia. They advocated a comprehensive approach integrating cultural, historical, and natural elements in the face of the challenges of cultural landscape conservation in Asia. The study also emphasises that through close cooperation with community residents, conservation measures can more fully reflect the community's cultural characteristics and promote residents' participation and support in cultural heritage protection to achieve harmony and unity of cultural heritage protection and community development.

Wang (2020), through a case study of the best irrigation system in Taiwan, emphasises that the extensive participation of community residents is essential for the successful conservation of historical and cultural landscapes. Community members not only deeply understand the local culture and history, but their participation increases the social acceptance and sustainability of conservation measures. Thus contributing to the sustainable social and cultural development of the region.

These studies show that cultural landscape protection should not only consider cultural and historical factors but also consider the natural environment, the active participation of community members, and other aspects of the impact to protect the material cultural heritage, but also pay attention to the inheritance of intangible heritage, the use of sustainable development strategy, aiming at achieving a win-win situation between heritage protection and community development.

### **Sustainable Development in Heritage Conservation**

In the paper, the researchers emphasise the importance of promoting environmental and social sustainability while preserving cultural heritage to balance cultural heritage conservation and sustainable development. They also show the evolving methodology and challenges in this field. Through these studies, scholars are actively searching for and implementing innovative approaches to achieve effective conservation of cultural heritage while ensuring environmental and social sustainability. Han, Wu, Tian, and Li (2018) made an in-depth analysis of the transformation from geopark protection to sustainable development, especially taking Huangshan World Geopark in China as a case, emphasising the importance of sustainable tourism in cultural heritage protection and demonstrating how to achieve the dual goals of heritage protection and economic growth through sustainable tourism.

Billore (2021), taking Indore City, India, as the research site, advocates the adoption of inclusive strategies to encourage the participation of different community sectors and residents in the protection of cultural heritage to deepen community residents' understanding of the value of cultural heritage, and highlight the role of cultural heritage in promoting social integration and enhancing social cohesion.

Using the Malacca World Heritage Site as a case study, Abdul Aziz et al. (2023) explored the role of biological heritage in promoting education for sustainable development, highlighted the importance of

community participation in the conservation of biological heritage, and discussed the relevance of such involvement to community education models.

Aziz, Ariffin, Ismail, and Alias (2020) put forward the application of non-formal education in the conservation of biological heritage in the face of the challenge of modernisation on intangible cultural heritage. He explored the significance of living heritage conservation education for communities.

These studies show that cultural heritage protection is not only achieved by community participation, sustainable tourism, and education but also needs to be gradually integrated into the concept of sustainable development to face the modernisation process and the growing demand for public participation and provide a long-term and adaptable strategy for the protection of cultural heritage.

### **Digital Preservation and Sustainable Development**

Digital protection and sustainable development are receiving increasing attention in cultural heritage protection. This review summarises and examines the latest research, highlighting the critical role of digital technologies in promoting sustainable cultural heritage.

Masenyana (2023) focuses on revitalising indigenous knowledge systems in South Africa and their digital conservation. The study points out that to protect Indigenous knowledge more effectively, it is not only necessary to establish better digital protection mechanisms between knowledge holders and communities but also to obtain corresponding policy support so that digital protection is critical in ensuring the long-term accessibility of Indigenous knowledge and supporting the sustainable development of Indigenous communities.

Lawan and Yusuf (2021) believe that digital documents will be a trend for the sustainable development of museum collections. The researchers believe that the transition from analog to digital documents is essential for the management and maintenance of collections, which not only enhances the impact of collections but also has a positive impact on promoting research, education, innovation, and economic growth, bringing broader economic and cultural benefits to society.

Mohanty and Swain (2022) discussed that the application of digital technology by micro, small, and medium enterprises (MSMEs) in India not only contributes to the protection of cultural heritage but also accelerates the enterprises' adaptation to technological changes so that cultural heritage can be preserved and promoted in new forms. It contributes to achieving the Sustainable Development Goals (SDGs) and reflects the growing importance of digital conservation in enhancing the sustainability of cultural heritage.

To sum up, community participation, policy support, and technological improvement play an essential role in successfully protecting cultural heritage. Integrating digital technology into the protection of cultural heritage not only effectively protects cultural heritage but also brings economic and social benefits to the community and ultimately promotes the realisation of Sustainable development Goals.

### **METHOD AND MATERIALS**

This study carried out the collection and analysis of the research on the site of Zhujiayu Village village and the data of the cultural heritage, analysed the analysis of the analysis of the relevant experts and scholars, and then explored its potential for promoting sustainable development..

#### **Literature Review**

The authors took advantage of the academic databases Google Scholar and ScienceDirect. They collected the relevant literature on "digital protection" of "sustainable development" of "sustainable development," to obtain the latest research dynamics and progress in the field and establish a solid academic foundation for the development of digital technology mining and evaluation and the cultural landscape of Zhujiayu Village's village.

## Data Collection

In the process of exploring the digital protection of the cultural landscape of Zhujiayu Village, the authors adopted three-dimensional laser scanning to capture the age, architectural style, material use, decorative details, etc. of the historical buildings in Zhujiayu Village, as well as the spatial layout and functional zoning of the buildings. Geographic information System (GIS) was used to collect and analyse the geographical characteristics and spatial design of Zhujiayu Village. To better protect and inherit the cultural heritage landscape of Zhujiayu Village, the authors conducted a quantitative analysis of the folk customs and folk art characteristics of Zhujiayu Village to find out the impact of these activities on the social structure and cultural identity of the village. Through this data-driven research method, conservation needs can be more accurately identified, the effects of conservation measures can be evaluated, and scientific decision support can be provided for future cultural landscape conservation efforts.

## Interviews

In this study, based on the heritage protection background of Zhujiayu Village, the researchers extensively collected qualitative data on digital conservation and sustainable development through semi-structured interviews, obtained in-depth insights from authoritative experts in the field, and then discussed the practical application and strategy of digital conservation and sustainable development in cultural heritage protection. The authors selected the heads of museums and archives, experts in digital conservation technology, and scholars who study sustainability. The extensive interview covers examples of the use of digital technology in cultural heritage conservation, challenges faced, and possible solutions, all of which aim to provide practical case studies and theoretical support for the protection of the cultural landscape in Zhujiayu Village. Through in-depth exchanges with these experts, the authors gained insights into the effective implementation of digital conservation measures in Zhujiayu Village and how to integrate the concept of sustainable development into the heritage conservation process. Through the collection and analysis of these qualitative data, the authors provide valuable raw materials for the digital protection of the cultural heritage of Zhujiayu Village and help formulate more scientific and reasonable protection plans and policy guidance for the follow-up research of Zhujiayu Village.

## Data Analysis

To deeply understand the current situation of digital conservation and sustainable development of Zhujiayu Village cultural heritage, the authors used NVivo software to encode and classify the qualitative data obtained through semi-structured interviews with experts, extract vital themes and profound insights, and carry out thematic analysis. For the quantitative data collected, the authors used GIS software to analyse the geographical location and environmental factors of Zhujiayu Village. Researchers used the statistical software SPSS to understand the socio-economic impact of Zhujiayu Village's cultural heritage. We used 3D modeling and visualisation software to create 3D models of Zhujiayu Village's cultural heritage for structural analysis and virtual restoration. Use Arches software to record, manage, and analyse the resources of Zhujiayu Village's cultural heritage. Finally, Python is used to find the mode and trend of protecting Zhujiayu Village's cultural heritage. Through the parallel analysis of quantitative and qualitative data, the authors were able to comprehensively identify and understand the problem from different perspectives, providing solid data support for the formulation of targeted protection strategies and implementation plans for the cultural heritage of Zhujiayu Village, ensuring the accuracy and effectiveness of protection measures, and also providing referential experience and methods for the protection practice of other similar cultural heritage sites.

## RESULTS AND DISCUSSION

### Digital Preservation of Cultural Heritage and Sustainability

Through a review and analysis of the literature, the authors analysed existing research on the preservation of digital cultural heritage and its relevance to sustainable development, thereby identifying

the latest academic insights and trends. The study first points out that the application of digital technology to the protection of cultural heritage, even in the case of continuous technological progress, the integration of technological, cultural, policy, and social development to form a long-term, adaptable approach, can show the detailed characteristics of cultural heritage for future generations, meet the needs of the public, and thus ensure the effective and sustainable protection of cultural heritage. Finally, this study reveals the need to balance the preservation of digital records and open access to the public. While the primary goal of digital conservation is to prevent the degradation or loss of heritage over time, there is also a growing focus on using these digital assets for educational, research, and cultural purposes, thereby contributing to developing a knowledge economy. In summary, the literature review associated with this study highlights that digital preservation in the context of sustainable development should integrate technological, cultural, policy, and social developments to form a long-term, adaptable approach to respond to rapidly changing technologies and the growing need for public participation to ensure effective and sustainable conservation of cultural heritage in the digital age.

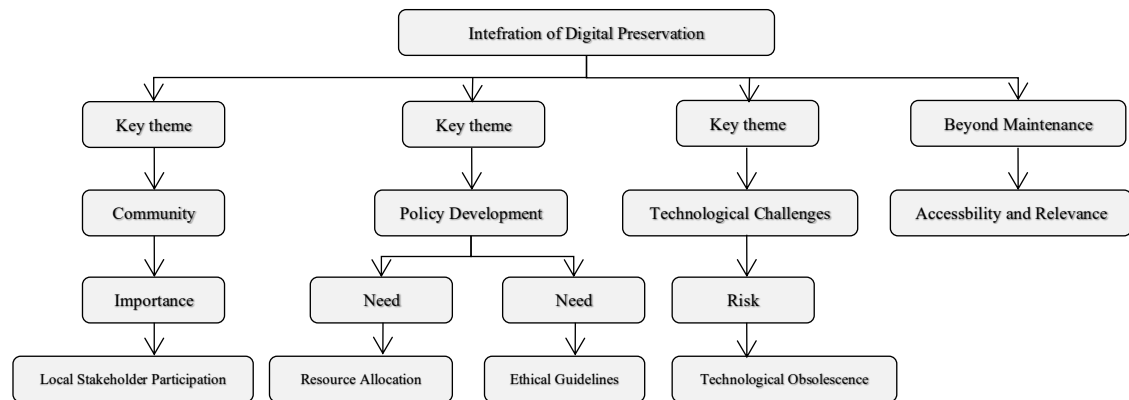


Fig. 4. Findings from the Literature Review

Source: Authors (2024)

### Digital Extraction of the Cultural Landscape

To better and more completely capture and preserve the unique and rich cultural heritage of Zhujiayu Village, the authors adopted photogrammetry technology, UAV shooting, etc., to collect images of the cultural heritage, such as historical characteristic buildings and traditional crafts and folk customs in the village from multiple angles. These images not only record the buildings' external characteristics but also the cultural heritage of Zhujiayu Village. We detailed the building's material, structure, and decorative details. We synthesised these images with the point cloud using ContextCapture software to build a complete three-dimensional point cloud-building model. This step further enhances the three-dimensional and detailed expression of the model, ensuring that the generated digital model meets a high standard of accuracy and authenticity, making the digitised cultural heritage more vivid and realistic. Through these advanced technical means, the research team created accurate and detailed digital archives to classify Zhujiayu Village's cultural heritage, providing valuable resources for the subsequent research, protection, and educational dissemination of Zhujiayu Village's cultural heritage. Researchers used video and audio recording methods to record traditional activities in the village and capture festival celebrations, folk art performances, and daily life scenes. These records contain rich visual information and carefully collect the scene's sound and environment, significantly enhancing the digital experience's vividness and realism. In particular, it is worth mentioning that the research has paid great attention to the folk art forms unique to Zhujiayu village, such as paper cutting, pottery, and embroidery. Through high-resolution scanning and photography, the researchers have detailed every detail of these artworks - color, texture, craftsmanship - so that the beauty of these artworks in digital display is intact. At the same time, GIS is used to map the natural landscape around Zhujiayu Village carefully. This covers the recording of geographical elements



such as mountains, rivers, and vegetation, which not only shows the geographical location and natural ecological environment of the village but also provides strong data support for the analysis of the village ecosystem and sustainable development strategies.



Fig. 5. Zhujiayu Village Historical Building

Source: Authors (2023)

The study also conducted an in-depth qualitative analysis of the socio-cultural background of Zhujiayu Village, collecting insights from residents, expert scholars, and cultural heritage managers through semi-structured interviews. These interview data provide valuable first-hand information for this study, which is helpful for a more comprehensive understanding of the value and protection needs of Zhujiayu Village's cultural heritage. Through this comprehensive and detailed digital extraction and analysis work, this study successfully recorded the characteristics of Zhujiayu Village's material culture and demonstrated its profound cultural connotation and historical value. These digital achievements provide a new perspective for academic research, rich teaching resources for educators, and a new experience platform for the public to understand better and feel Zhujiayu Village, a village with a long history. Through in-depth analysis of the data of Zhujiayu Village and expert consultation, the research results obtained will help Zhujiayu Village to formulate more accurate, more effective, and more targeted protection measures and provide scientific basis and decision-making support for the subsequent protection and sustainable development of Zhujiayu Village's cultural heritage.



Fig. 6. Zhujiayu Village Architectural Components

Source: Authors (2023)



Fig. 7 Zhujiayu Village Traditional Handicrafts

Source: Authors (2023)



Fig. 8. Zhujiayu Village Traditional Handicrafts

Source: Authors (2023)

### Survey Methodology

In this study, the protection and sustainable development of Zhujiayu Village's cultural landscape is deeply consulted and discussed by Delphi's expert consultation method. Through repeated consultation and feedback with experts, digital technology's application, development potential, and challenges in the protection of cultural heritage in Zhujiayu Village were analysed and evaluated.

The methodology aims to bring together the rich insights and experience of experts in the field to reveal the application of digital conservation in sustainable cultural heritage conservation practices, challenges, and future trends. To this end, the research team invited 20 experts with deep backgrounds and expertise in the fields of cultural heritage conservation, digital technology applications, and sustainable development to participate in the survey. Their broad perspectives are drawn from diverse disciplines:

- (i) Museum and archive staff
- (ii) Cultural heritage conservation professionals
- (iii) Digital technologists
- (iv) Sustainability researchers
- (v) Educators
- (vi) Government policymakers
- (vii) Village management practitioners

Feedback from the experts provides valuable multi-dimensional insights into this study. The Delphi Survey is a multi-round consultation process that aims to gradually converge to a shared understanding and perspective through continuous expert discussion and feedback. In the first consultation, the experts put forward preliminary views on the digital protection and sustainability of Zhujiayu Village cultural heritage based on their professional cognition and practical experience. In subsequent rounds of consultation, the research team gave the experts feedback on the summary results of the previous discussions and asked for

further comments and in-depth discussions to facilitate the exchange of knowledge and the collision of ideas.

Through a detailed analysis of the expert opinions collected using qualitative analysis techniques, the researchers identified the key themes and consensus points. They paid full attention to the differences and unique insights in the expert opinions. This in-depth analytical approach greatly enhanced the researchers' understanding of digital conservation's role in preserving Zhujiayu Village's cultural heritage and clearly pointed to ways in which it can be integrated with the Sustainable Development Goals.

Using the Delphi method, the researchers could comprehensively collect the profound insights of experts in the Zhujiayu Village cultural heritage protection field from a broad and multi-angle perspective. This not only makes people understand the current cultural heritage protection but also puts forward valuable guidance and suggestions for the future digital protection of Zhujiayu Village cultural heritage protection to make the sustainable development of Zhujiayu Village cultural heritage protection.

### Survey Results

In this study, the research team extensively collected valuable opinions from tourists, digital conservation technicians, educators, libraries, museums, and other experts through the Delphi method. The feedback from the experts revealed the central position of digital conservation technology in protecting and disseminating cultural heritage. It provides valuable reference information for the digital protection and sustainable development of Zhujiayu Village's cultural heritage. 90% of the experts believe that digital technology for the protection of cultural heritage is an essential technological means, not only to improve the efficiency of cultural heritage protection, to enable cultural heritage to be preserved longer and better, but also to promote public understanding and participation, thereby enhancing the social impact of cultural heritage. However, the study also points out several challenges in digital conservation practices. About 80% of experts cited a need for more funding, rapid technology updates, inadequate and timely professional training, and expensive equipment as significant challenges in implementing digital protection projects. In addition, more than two-thirds of the experts (75%) highlighted the importance of community participation in building awareness and passing on cultural heritage as a critical factor in ensuring that digital conservation projects are both culturally relevant and realistic. About 85% of the experts recommended that governments take the lead, combined with companies with expertise in digital protection technology, and develop a more comprehensive policy and management system for financial assistance, technical standards development, and community participation measures to support better implementation of digital protection projects. 70% of the experts believe that the key to the adaptability and continuous innovation of digital protection technology is to adopt flexible technical solutions to adapt to the rapid changes in the digital environment for the professional technology that conforms to the characteristics of Zhujiayu Village. At the same time, about 65% of experts believe that digital conservation projects should focus on their educational value and use digital means to improve public understanding and appreciation of cultural heritage.

Based on expert opinions, these research results provide profound insights into the digital protection and sustainable development of Zhujiayu Village's cultural heritage. They are an essential reference for future strategic planning and implementation. These insights will help to promote the in-depth development of Zhujiayu Village cultural heritage protection and ensure its complete protection and rational use in the digital age. Through these comprehensive research results, this study is expected to provide a scientific basis and offer practical guidance for the protection of Zhujiayu Village and other similar cultural heritage sites, thereby jointly advancing the cause of cultural heritage preservation.

Table 1. Expert Delphi Survey Results on Digital Preservation and Sustainable Development in Zhujiayu Village's Cultural Heritage Conservation

| Survey Item                               | Percentage of Expert Consensus | Key Insights or Recommendations   |
|---|--------------------------------|---|
| Importance of Digital Preservation        | 90%                            | Digital means can more effectively preserve and disseminate cultural heritage                             |
| Challenges in Implementation              | 80%                            | Funding constraints, rapid changes in technology updates, lack of professional skills training            |
| Importance of Community Involvement       | 75%                            | Participation of community members helps ensure the cultural sensitivity and practicality of the projects |
| Policy and Governance Recommendations     | 85%                            | Need for more comprehensive policies and governance structures to support digital preservation projects   |
| Technological Adaptability and Innovation | 70%                            | Adopt flexible technological solutions to adapt to the rapidly changing digital environment               |
| Educational Value of Digital Preservation | 65%                            | Enhance public understanding and appreciation of cultural heritage through digital means                  |

Source: Author, 2024

## DISCUSSION

In the critical analysis chapter of this study, the authors explore the findings in depth and explain how they contribute to the understanding and improvement of cultural heritage conservation practices in Zhujiayu Village. Through an in-depth study of the digital protection and sustainable development of Zhujiayu Village's cultural heritage, this study interprets the survey results in detail, especially the data obtained using the Delphi expert consultation method. The authors further discuss the links between these findings and existing literature and theories and emphasise the importance of these links in the specific context of Zhujiayu cultural heritage conservation.

In a central discussion of the study, the researchers focused on the challenges and opportunities to protect cultural heritage and promote its sustainable development digitally. They delved into significant issues such as inadequate funding, the challenge of updating technology, and the importance of involving communities in conservation efforts. The study also found that by employing innovative scientific and technological means and embracing new policy changes, the challenges faced can be transformed into opportunities that facilitate the protection of cultural heritage. Research results are essential in practice. These findings help us better plan for Zhujiayu's cultural heritage conservation and illustrate how digital conservation and sustainable development can be made more effective. Therefore, the researchers further proposed some policy recommendations, hoping to support Zhujiayu Village's cultural heritage protection work. These include how to raise funds, how to get communities more involved, and how to raise public awareness of heritage conservation.

At the same time, there are still some shortcomings in the study, and the possible direction of future research is proposed. For example, further research could be conducted to determine which of the different ways of engaging community residents is more effective or to assess the potential of emerging technologies to protect cultural heritage. Overall, the study's results highlight the study's main findings and the significance and possible long-term impact of these findings on the protection of cultural heritage in Zhujiayu Village.

## CONCLUSION

This study uses digital technology to protect the cultural heritage of Zhujiayu Village, aiming to realise the lasting inheritance of material and intangible cultural heritage through technical means. Through the Delphi expert consultation method, the authors have extensively collected expert opinions and found that the digital conservation strategy can effectively reduce the financial pressure caused by long-term maintenance, and can promote the participation of villagers in the protection of cultural heritage, enhance their awareness of cultural inheritance, to protect cultural heritage better. Based on the above findings, this



paper further emphasises the importance of integrating digital conservation strategies with the Sustainable Development Goals, especially the active participation of village managers and villagers in implementing cultural heritage protection measures. The study confirms the need to combine digital conservation approaches with long-term sustainable development goals, which are essential for preserving and transmitting cultural heritage. Ensuring the participation of local communities and relevant stakeholders provides the cultural appropriateness of conservation measures and enhances the public's sense of responsibility and pride in conserving cultural heritage. To comprehensively improve the protection level of Zhujiayu Village's cultural heritage and promote its sustainable development, this paper puts forward a series of suggestions for the optimisation of policy support, the strengthening of technology application, and the implementation of education plans to enhance the public's awareness and participation in heritage protection, so that the cultural heritage protection can better adapt to social changes. Meet the demands of the digital age. To sum up, this study provides a new perspective and hope for the protection of Zhujiayu Village's cultural heritage through the use of digital technology, promotes the practice of sustainable development, creates a precious opportunity for the protection and inheritance of Zhujiayu Village's cultural heritage, and ensures that people can continue to protect and feel the rich cultural inheritance from generation to generation in the future. This study provides new thinking for the current protection work of Zhujiayu Village cultural heritage and lays a solid foundation for future academic research and practical operation.

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## CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

## AUTHORS' CONTRIBUTIONS

Wang Tongyun conducted and conceptualised the research, wrote and revised the article with the assistance of Zhou Shiwan. Suriati Ahmad, Norhafizah Abdul Rahman and Hairunkamal Wahid supervised the research process and deliverables. Izham Ghani led the review process, made revisions, and approved the article for submission.

## REFERENCES

- Abdul Aziz, N. A., Mohd Ariffin, N. F., Ismail, N. A., & Alias, A. (2023). Community participation in the importance of living heritage conservation and its relationships with the community-based education model towards creating a sustainable community in Melaka UNESCO world heritage site. *Sustainability*, 15(3), 1935. <https://doi.org/10.3390/su15031935>
- Aziz, N. A. A., Ariffin, N. F. M., Ismail, N. A., & Alias, A. (2020). The Non-formal Education Initiative of Living Heritage Conservation for the Community towards Sustainable Development. *Asian Journal of Quality of Life*, 5(18), 43–56. <https://doi.org/10.21834/ajqol.v5i18.205>
- Billore, S. (2021). Cultural Consumption and Citizen Engagement—Strategies for Built Heritage Conservation and Sustainable Development. A Case Study of Indore City, India. *Sustainability*, 13(5), 2878. <https://doi.org/10.3390/su13052878>

- Han, J., Wu, F., Tian, M., & Li, W. (2018). From geopark to sustainable development: Heritage conservation and geotourism promotion in the Huangshan UNESCO Global Geopark (China). *Geoheritage*, 10, 79-91. <https://doi.org/10.1007/s12371-017-0227-2>
- Lawan, S., & Yusuf, U. L. (2021). Digital documentation of museum collections for sustainable development. *Journal of Social Sciences Advancement*, 2(3), 85-91.
- Masenya, T. M. (2023). Revitalization and Digital Preservation of Indigenous Knowledge Systems for Sustainable Development of Indigenous Communities in South Africa. *The Serials Librarian*, 84(5-8), 86-102. <https://doi.org/10.1080/0361526X.2023.2277962>
- Mohanty, L., & Swain, S. C. (2022). Use of Digital Technologies by the Msme to Preserve Cultural Heritage of India and Achieve Sustainable Development Goals. *ECS Transactions*, 107(1), 14343. <https://doi.org/10.1149/10701.14343ecst>
- Pandey, R., & Kumar, V. (2020). Exploring the Impediments to Digitization and Digital Preservation of Cultural Heritage Resources: A Selective Review. *Preservation, Digital Technology & Culture*, 49(1), 26-37. <https://doi.org/10.1515/pdtc-2020-0006>
- Perera, K. (2023). Heritage at Risk: Digital Preservation of Traditional Cultural Heritage (TCH) in Sri Lanka. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 48, 1197–1207. <https://doi.org/10.5194/isprs-archives-XLVIII-M-2-2023-1197-2023>
- Rössler, M., & Lin, R. (2018). Cultural landscape in world heritage conservation and cultural landscape conservation challenges in Asia. *Built Heritage* 2(3): 3–26. <https://doi.org/10.1186/BF03545707>
- Sari, D. C., & Munandar, A. (2020, May). Characteristic assessment and cultural landscape conservation of Urug Indigenous Village. In *IOP Conference Series: Earth and Environmental Science* (Vol. 501, No. 1, p. 012045). IOP Publishing. <https://doi.org/10.1088/1755-1315/501/1/012045>
- Učakar, A. et al. (2022). 3D Digital Preservation, Presentation, and Interpretation of Wooden Cultural Heritage on the Example of Sculptures of the FormaViva Kostanjevica Na Krki Collection. *Applied Sciences*, 12(17), 8445. <https://doi.org/10.3390/app12178445>
- Wang, C. H. (2020). The necessity of taking a community approach in a historical cultural landscape conservation: a case of the Jianan Irrigation System in Taiwan. *GeoJournal*, 85(1), 107–126. <https://doi.org/10.1007/s10708-018-9950-8>
- Zhou Y, Sun J, Huang Y. (2019). The Digital Preservation of Intangible Cultural Heritage in China: A Survey. *Preservation, Digital Technology & Culture* 48(2), 95–103. <https://doi.org/10.1515/pdtc-2019-0004>



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