# DIGITAL TECHNOLOGY INTEGRATION IN THE STRATEGY FOR PRESERVING AND PROMOTING KHMER CULTURAL HERITAGE IN SOUTHERN VIETNAM

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Received: 2 May 2025; Revised: 18 May 2025; Accepted: 31 May 2025

## ABSTRACT

This study analyzes the role and potential of digital technology in preserving and promoting Khmer cultural heritage in Southern Vietnam, while proposing a digital technology integration model appropriate for the local context. Through qualitative research methodology combining content analysis of selected documents from reputable databases (Scopus and WoS) and in-depth interviews with 15 experts from heritage management, digital technology, tourism sectors, and Khmer community representatives, the research employed NVivo14 software for data processing and analysis to identify key themes and relationships. The findings demonstrate the significant potential of digital technology in digitization, preservation, and transmission of heritage values, particularly through virtual reality/augmented reality applications and multimedia interactive platforms. The study proposes a three-layer digital technology integration model, comprising: digital infrastructure and database, interaction and experience platforms, and digital distribution and promotion channels. For effective implementation, close coordination among stakeholders is essential, emphasizing the leadership role of local authorities and active participation of the Khmer community, thereby providing scientific and practical foundations for policy formulation and deployment of technological solutions in preserving Khmer cultural heritage in Southern Vietnam.

*Keywords:* Digital technology, cultural heritage, Southern Khmer.

## 1. INTRODUCTION

In the current context of digital transformation, the application of digital technologies in cultural heritage preservation and promotion has become an inevitable global trend. Particularly, regarding the Khmer cultural heritage in Southern Vietnam - one of Vietnam's most distinctive and rich cultural legacies, the integration of digital technology presents both significant opportunities and challenges that require systematic research and investigation.

Although there have been several studies on the application of digital technologies in cultural heritage preservation in general, significant research gaps remain in the integration of digital technologies into the preservation of Southern Vietnam's Khmer cultural heritage. Nguyen discovered that the application of 3D laser scanning technology and Heritage Building Information Modeling (HBIM) in Khmer heritage conservation remains in its infancy and faces numerous challenges regarding human resources and implementation costs [1, 2]. Furthermore, Ha & Van's research indicates that the Southern Khmer community is undergoing significant cultural transformations, necessitating appropriate technological

solutions for preserving and promoting traditional cultural values [3, 4]. Notably, Wang argues that while virtual and augmented reality technologies hold great potential for enhancing the protection and promotion of cultural landscapes, no comprehensive integration model has been proposed for the digitalization of Southern Khmer cultural heritage [5, 6] Additionally, Khanh emphasizes that despite existing policy directives on human resource development, there remains an absence of a scientific framework for systematically and sustainably integrating digital technology in Khmer cultural heritage preservation [7, 8].

Based on the aforementioned practical context, this research aims to: (1) evaluate the current status of digital technology applications in preserving Southern Khmer cultural heritage; (2) analyze the factors influencing the integration of digital technology in heritage preservation; and (3) propose a digital technology integration model appropriate to the local context. The research findings are expected to provide a scientific foundation for policy formulation and implementation of sustainable digitalization solutions for Southern Khmer cultural heritage.

## 2. LITERATURE REVIEW

### 2.1. The concept of digital technology in cultural heritage context

In the current digital era, digital technology plays a pivotal role in preserving and promoting the unique values of Southern Khmer cultural heritage. Through innovative solutions, it not only expands accessibility but also establishes a solid foundation for sustainable development of the distinctive cultural values of the Khmer community.

Specifically, advanced digitization techniques such as 3D laser scanning and photogrammetry are being applied to create detailed digital replicas of ancient Khmer temples, sculptural artifacts, and unique reliefs in Khmer religious architecture. This approach not only preserves intricate architectural details but also safeguards the intangible cultural values associated with these sacred spiritual spaces [9, 10]. Concurrently, the implementation of the "digital twin" concept through Heritage Building Information Modeling (HBIM) is being researched and deployed, enhancing the efficiency of management, maintenance, and restoration of ancient Khmer architectural structures in a systematic and scientific manner [11]

Regarding heritage experience and dissemination, Virtual Reality (VR) and Augmented Reality (AR) technologies create opportunities for establishing virtual museums, enabling viewers to explore Khmer temple architecture, learn about decorative arts, sculptures, and religious ceremonies in an interactive and immersive manner [12]. Notably, digital platforms facilitate the widespread promotion of Southern Khmer culture's unique beauty to both domestic and international audiences, contributing to cultural tourism development and enhancing understanding of Vietnam's cultural diversity [13]. These technologies are also integrated into local educational programs, helping both Khmer and non-Khmer younger generations develop a deeper understanding of their cultural heritage [14].

In conclusion, the effective application of digital technology in preserving Southern Khmer cultural heritage requires close collaboration among stakeholders, from local communities and researchers to heritage management authorities. Only through harmonious integration of modern technology and indigenous knowledge can heritage preservation truly become effective, both maintaining traditional values and creating momentum for the sustainable development of Khmer culture in the future.

### 2.2. The role of digital technology in cultural heritage preservation

In the digital era, digital technology has emerged as a powerful tool in preserving cultural heritage, particularly in the context of Southern Khmer cultural heritage preservation. With superior advantages in storage and documentation capabilities, digital technology not only facilitates the preservation of distinctive cultural values but also reveals new approaches to harness and maximize heritage potential.

In practice, 3D laser scanning and photogrammetry technologies have been widely deployed to create detailed digital documentation of Khmer architectural structures and artistic artifacts, particularly ancient temples and their intricate sculptural details, thereby enhancing documentation accuracy and enabling high-resolution digital replications [15]. Notably, the collected point cloud data captures different preservation stages of Khmer heritage sites, providing valuable historical records for conservation efforts [16]. Simultaneously, Heritage Building Information Modeling (HBIM) has proven its effectiveness in integrating various data types, facilitating the reinterpretation and documentation of Khmer architectural works, especially in complex temple compounds with multiple architectural layers and historical modifications [17–18]. Meanwhile, 3D semantic modeling enables the creation of rich digital models, facilitating the understanding and management of complex historical monuments such as ancient Khmer temple architecture and its associated religious artifacts [19–20].

Regarding interaction and experience, Virtual Reality (VR) and Augmented Reality (AR) technologies have revealed new dimensions for immersive cultural experiences, allowing users to interact with Khmer historical heritage sites and develop deeper understanding of cultural values embedded in temple architecture, religious ceremonies, and traditional customs [18]. These technologies are particularly valuable for preserving and presenting intangible cultural elements such as Khmer religious rituals, traditional ceremonies, and performing arts.

Consequently, digital technology is fundamentally reshaping the model of preserving and promoting Khmer cultural heritage through providing innovative tools for documentation, visualization, and interaction. This integration not only ensures the preservation of cultural values for future generations but also establishes a solid bridge between traditional heritage and contemporary audiences, thereby contributing to sustainable development goals. The application of these technologies in Southern Khmer heritage conservation represents a crucial step toward comprehensive digital preservation while respecting and enhancing the authentic cultural values of the Khmer community.

## 3. RESEARCH METHODOLOGY

This study employs a qualitative research methodology to analyze the role and potential of digital technology in preserving Southern Khmer cultural heritage, aiming to propose a digital technology integration model appropriate for the local context. The research process was systematically designed encompassing two primary phases: content analysis and in-depth interviews.

### 3.1. Content analysis methodology

The initial phase focused on collecting and analyzing academic works related to digital technology applications in heritage preservation. A systematic search was conducted using the Scopus database with key search terms: "digital heritage preservation", "virtual reality", "augmented reality", "digital platforms", "Khmer heritage" and "Vietnam" covering the period from 2015 to late 2024.The document selection criteria encompassed: (1) publications in peer-

reviewed international journals; (2) content directly relevant to digital technology applications in cultural heritage preservation; and (3) research outcomes featuring practical digital technology implementation models. From an initial pool of 120 articles, 19 scholarly works were selected, with particular emphasis on studies examining virtual reality/augmented reality and interactive multimedia platforms in heritage preservation.

### 3.2. In-depth interview methodology

The author conducted in-depth interviews with 15 multidisciplinary experts, selected through a combination of purposive and snowball sampling methods to access specialists with extensive expertise in digital technology and heritage preservation. The expert panel composition included: 4 Khmer cultural heritage researchers, 3 digital technology specialists with expertise in virtual reality and interactive platforms, 3 heritage site managers from provincial Departments of Culture, Sports and Tourism, 3 representatives from technology and tourism enterprises, and 2 Khmer community representatives. The interviews were conducted between February and April 2025, with each session lasting 60-90 minutes, employing semi-structured interview guidelines that focused on three primary themes: (1) evaluation of digital technology's potential in digitizing, preserving, and transmitting heritage values; (2) discussion of a three-layer digital technology integration model comprising digital infrastructure and database, interactive platform and experience, and digital distribution and promotion channels; (3) proposed solutions for stakeholder collaboration in model implementation. All interviews were audio-recorded (with participants' informed consent) and fully transcribed. The interview data were analyzed using NVivo14 software, focusing on key themes related to digital technology potential, integration models, and implementation coordination mechanisms, thereby establishing a foundation for developing policy and technological solution frameworks for the sustainable preservation of Southern Khmer cultural heritage.

## 4. RESEARCH RESULTS

### 4.1. Current status of digital technology integration in Southern Khmer cultural heritage exploitation: a literature review analysis

The integration of digital technology in Southern Khmer cultural heritage exploitation, particularly in the Mekong Delta region, remains in its nascent stage. Although efforts have been made to implement 3D laser scanning technology and Heritage Building Information Modeling (HBIM) in heritage preservation the deployment faces significant challenges regarding experienced human resources and high equipment costs [2]. Furthermore, virtual reality and augmented reality technologies are being explored for enhanced protection and promotion of cultural landscapes while digitization technology and digital documentation are being investigated for intangible cultural heritage preservation. From a policy perspective, the government has established guidelines for human resource development in preserving and promoting Khmer cultural heritage values ; however, substantial challenges persist in balancing cultural significance preservation with modern technology integration. The Khmer community in Southern Vietnam has undergone significant cultural transformations through inter-ethnic interactions, necessitating active community engagement in preservation efforts. To achieve sustainable development, a more comprehensive integration of digital technology in cultural heritage preservation is required, encompassing improved integration levels, user needs fulfillment, and enhanced social awareness of cultural heritage values [9].

### 4.2. Current status of digital technology integration in Southern Khmer cultural heritage: expert interview analysis

The analysis of 15 in-depth interviews with multidisciplinary experts revealed multifaceted perspectives on digital technology integration in Southern Khmer cultural heritage preservation. Heritage researchers (R1, R2, R3, R4) from Tra Vinh University and the Southern Institute of Arts and Culture emphasized the significance of digitizing traditional rituals and festivals such as Chol Chnam Thmay and Ok Om Bok, with R2 and R4 particularly focusing on preserving traditional dances and Du ke music through 360-degree recording technology. Concurrently, digital technology experts (T1, T2, T3) from technology companies in Ho Chi Minh City and Can Tho proposed implementing Virtual Reality (VR) and Augmented Reality (AR) technologies to recreate Khmer temple architectural spaces, with T1 highlighting the potential for virtual tours of prominent temples such as Doi Pagoda (Soc Trang) and Ang Pagoda (Tra Vinh).

From a management perspective, representatives from the Departments of Culture, Sports and Tourism (M1, M2, M3) in Soc Trang, Tra Vinh, and Kien Giang agreed on the need for a centralized digital database, with M2 proposing a locally distributed data management model interconnected through a common digital platform. Business representatives (B1, B2, B3) from tourism and technology companies in An Giang and Hau Giang emphasized the potential of multilingual mobile applications (Vietnamese-Khmer-English) for heritage promotion, with B1 suggesting the integration of e-payment and online tour booking features. Notably, Khmer community representatives (C1, C2) from Tra Vinh and Soc Trang expressed support for heritage digitization while raising concerns about preserving the sanctity of religious ceremonies, with C1 proposing consultation with temple abbots before implementing digitization projects at pagodas.

NVivo14 analysis revealed three predominantly discussed themes: the need for a centralized digital database (mentioned by 87% of experts), VR/AR technology application in heritage preservation (supported by 73% of experts), and the importance of community participation in the digitization process (emphasized by 93% of experts). The experts consensually agreed that a three-layer digital technology integration model should be implemented according to an appropriate roadmap, beginning with standardized digital database construction, progressing to interactive application development, and finally expanding diverse digital distribution channels. To provide a more comprehensive and reliable perspective on the research issue, a systematic comparison between the literature review findings and expert interview results is necessary.

*Table 1.* A systematic comparison of literature review and expert interview results.
Source: author's analysis and synthesis, 2025.

| Criteria | Literature review | Expert interviews | Convergence level |
|---|---|---|---|
| 1.Current state of technology application | • Initial developmental stage<br>• Implementation of 3D laser scanning and HBIM<br>• Research on VR/AR applications | • Early development phase<br>• Proposed VR/AR implementation for temple architectural visualization<br>• Utilization of 360-degree recording technology | High |

| Criteria | Literature review | Expert interviews | Convergence level |
|---|---|---|---|
| 2.Implementation challenges | • Shortage of experienced human resources<br>• High equipment costs<br>• Difficulty balancing preservation with modernization | • Need for specialized professional training<br>• Substantial technological investment requirements<br>• Concerns regarding preservation of heritage sanctity | High |
| 3. Community role | • Necessity for active community engagement<br>• Recognition of cultural evolution through inter-ethnic interactions | • 93% of experts emphasized community participation significance<br>• Required consultation with temple abbots<br>• Community supports digitization while maintaining sacred aspects | High |
| 4. Development trajectory | • Need for comprehensive digital integration<br>• Enhancement of integration levels<br>• Elevation of social awareness | • Implementation of three-layer integration model<br>• Development of centralized digital database (87% expert consensus)<br>• Appropriate phased implementation roadmap | Medium |
| 5. Technological solutions | • 3D laser scanning technology<br>• HBIM modeling<br>• Document digitization | • 360-degree recording<br>• VR/AR applications (73% expert endorsement)<br>• Multilingual mobile applications<br>• Online payment and tour booking platforms | Medium |
| 6. Policy aspects | • Human resource development guidelines<br>• Heritage preservation and value promotion policies | • Proposed locally distributed data management model<br>• Integration through common digital platform | Low |

Through comparative analysis of literature review and expert interviews on the digitization of Khmer cultural heritage in the Mekong Delta, the research has identified notable similarities regarding the rudimentary state of technology application, resource challenges, and the pivotal role of local communities. Notably, expert interviews provided valuable quantitative data, with 93% of experts emphasizing the significance of community engagement and 87% supporting the establishment of a centralized digital database. However, there remains a considerable gap between theory and practice, particularly in policy aspects and technological solutions. This situation necessitates an urgent requirement to develop an appropriate development roadmap, with special emphasis on training specialized human resources and maintaining a delicate balance between modernization trends and the

preservation of sacred traditional cultural values. These findings not only hold academic significance but also provide a solid practical foundation for strategizing the digitization of Khmer cultural heritage in the Mekong Delta region. The research implications suggest a comprehensive approach that bridges theoretical frameworks with practical implementation, while respecting the intrinsic cultural values and community participation in heritage preservation efforts. This understanding is fundamental for sustainable cultural tourism development and digital transformation initiatives in the region's heritage management system.

## 5. PROPOSED SOLUTIONS AND FRAMEWORK

### 5.1. Strategic solutions and recommendations

Based on the comprehensive literature review and expert interviews, this research proposes four key strategic solutions to enhance the effectiveness of digital technology integration in preserving the Khmer cultural heritage in the Mekong Delta region.

Firstly, the establishment of a centralized digital database serves as a fundamental cornerstone. This necessitates the implementation of a digitally distributed data system across localities, interconnected through a common digital platform, as recommended by management experts from the Department of Culture, Sports and Tourism. Priority should be given to digitizing traditional ceremonies and festivals such as Chol Chnam Thmay and Ok Om Bok, as well as intangible heritage elements including traditional dance forms and Du ke musical performances. Concurrently, the application of 3D laser scanning technology and HBIM (Heritage Building Information Modeling) should be intensified to create detailed digital replicas of architectural structures.

Secondly, the development of an interactive multimedia platform requires significant attention through the implementation of a trilingual mobile application (Vietnamese-Khmer-English). This application should incorporate features such as VR/AR-enabled virtual tours of prominent pagodas, integrated electronic payment systems and online tour booking capabilities, alongside interactive content about Khmer culture.

Thirdly, enhancing community engagement plays a pivotal role in ensuring project sustainability. This can be achieved through establishing consultation mechanisms with temple abbots and Khmer community representatives prior to implementing digitization projects, organizing digital technology training programs for local communities, and developing a network of local cultural collaborators.

Finally, the systematic development of specialized human resources should be implemented through organizing advanced training courses on digital technology in heritage preservation, fostering collaborations with universities and research institutions, while simultaneously building a team of technical experts in heritage digitization technologies.

### 5.2. Proposed framework for digital technology integration in Southern Khmer cultural heritage preservation

Based on research findings derived from the synthesis of in-depth documentary analysis and expert consultations in the fields of digital technology and heritage preservation, this study proposes a three-tiered digital integration framework founded on the principles of layered architecture and systematic integration, as follows:

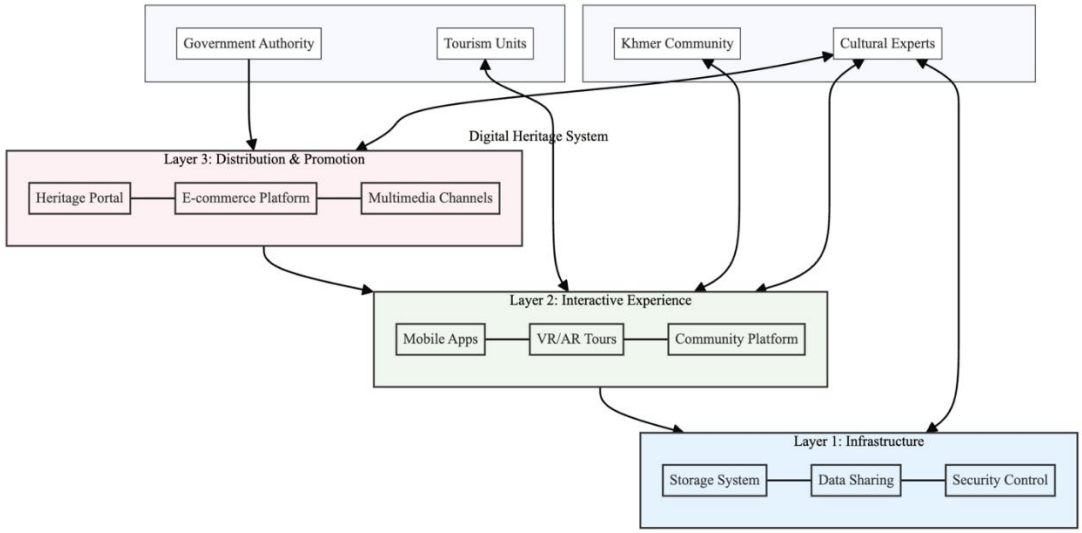


*Figure 1*. Conceptual framework of Khmer cultural heritage digital system.
Source: Author's proposal, 2025.

The analysis of the proposed digital system framework reveals three distinct layers with specific components and implementation considerations:

Firstly, the digital infrastructure and database layer serves as the foundation of the entire system. Analysis indicates that this layer must comprise three key components: (1) a locally distributed data storage system, (2) a centralized data connection and sharing platform, and (3) a security and access control system. This conclusion is derived from studying successful global digital heritage models and consensus among technology experts.

Secondly, based on user needs analysis and digital experience expert consultation, the research identifies that the interactive and experience platform layer should focus on three technological solutions: (1) a multilingual mobile application, (2) VR/AR-enabled virtual tour systems, and (3) a community interaction platform. These solutions are evaluated as most appropriate for creating meaningful and enriched digital experiences for users in the context of Khmer cultural heritage.

Thirdly, research findings indicate that the digital distribution and promotion channels layer should encompass: (1) a Khmer cultural heritage information portal, (2) an e-commerce platform for cultural products, and (3) multimedia digital communication channels. This conclusion emerges from analyzing public information access trends and implementation experiences from heritage digitization projects.

From an implementation perspective, consulted experts emphasize that this model should be executed through a three-phase roadmap: (1) establishing standardized digital databases, (2) developing interactive applications and (3) expanding digital distribution channels. Notably, the research highlights the critical importance of balancing the sanctity of heritage preservation with modern technological applications, while ensuring active community engagement throughout the process.

This proposed framework is the outcome of rigorous research, combining document analysis methodology with expert consultation, establishing a comprehensive reference framework for integrating digital technology in Southern Khmer cultural heritage preservation. By elucidating the structure and interrelationships between components, this

model provides a scientific foundation for implementing sustainable and effective heritage digitization solutions.

## 6. CONCLUSION

This research has achieved its objectives through a comprehensive analysis of the role and potential of digital technology in preserving Southern Khmer cultural heritage, while proposing an integrated digital technology model suitable for the local context. Based on analytical findings from 19 carefully selected academic works and in-depth interviews with 15 multidisciplinary experts, the study reveals that while the application of digital technology in Southern Khmer heritage preservation is in its nascent stage, there exists substantial development potential, particularly in digitizing intangible heritage and creating interactive experiences. Notably, the proposed three-layer digital integration model not only reflects global technological trends but also accounts for local cultural specificities, with 93% of experts emphasizing the importance of community engagement. Furthermore, the three-phase implementation roadmap ensures project feasibility and sustainability, prioritizing the establishment of standardized digital databases as a foundation for subsequent developments. However, realizing this model requires close coordination among stakeholders, particularly emphasizing the leadership role of local authorities and active participation from the Khmer community. Moreover, maintaining a balance between preserving the sacred nature of heritage and implementing modern technology emerges as a crucial factor determining the future success of the Southern Khmer cultural heritage digitization process.

*Future research approaches*

Future research endeavors should focus on developing effectiveness evaluation metrics for the digital technology integration model in Southern Khmer heritage preservation. Additionally, investigating stakeholder coordination mechanisms, particularly public-private partnership models in heritage digitization projects, warrants further attention to ensure the sustainability of digital transformation processes in this domain.

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## TÓM TẮT

# TÍCH HỢP CÔNG NGHỆ SỐ TRONG CHIẾN LƯỢC BẢO TỒN VÀ PHÁT TRIỂN DI SẢN VĂN HÓA KHMER Ở MIỀN NAM VIỆT NAM

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Nghiên cứu này phân tích vai trò và tiềm năng của công nghệ số trong việc bảo tồn và phát huy di sản văn hóa Khmer ở miền Nam Việt Nam, đồng thời đề xuất một mô hình tích hợp công nghệ số phù hợp với bối cảnh địa phương. Thông qua phương pháp nghiên cứu định tính kết hợp phân tích nội dung các tài liệu được chọn từ các cơ sở dữ liệu uy tín (Scopus và WoS) và phỏng vấn chuyên sâu với 15 chuyên gia trong lĩnh vực quản lý di sản, công nghệ số, ngành du lịch và đại diện cộng đồng người Khmer, nghiên cứu đã sử dụng phần mềm NVivo14 để xử lý và phân tích dữ liệu nhằm xác định các chủ đề và mối quan hệ chính. Các phát hiện chứng minh tiềm năng to lớn của công nghệ số trong quá trình số hóa, bảo tồn và truyền tải các giá trị di sản, đặc biệt là thông qua các ứng dụng thực tế ảo/thực tế tăng cường và các nền tảng tương tác đa phương tiện. Nghiên cứu đề xuất một mô hình tích hợp công nghệ số ba lớp, bao gồm: cơ sở hạ tầng và cơ sở dữ liệu số, nền tảng tương tác và trải nghiệm, và các kênh phân phối và quảng bá số. Để triển khai hiệu quả, cần có sự phối hợp chặt chẽ giữa các bên liên quan, nhấn mạnh vai trò lãnh đạo của chính quyền địa phương và sự tham gia tích cực của cộng đồng người Khmer, từ đó cung cấp cơ sở khoa học và thực tiễn cho việc xây dựng chính sách và triển khai các giải pháp công nghệ trong bảo tồn di sản văn hóa Khmer ở Nam Bộ.

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