Digital Technology Application in Preserving and Promoting Traditional Cultural Values: International Experience and Lessons for Vietnam

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ABSTRACT: Digital technology is creating a turning point in global cultural heritage preservation, clearly demonstrated through pioneering projects like CyArk (USA) with its capability to 3D scan over 200 monuments - from Angkor Wat temple to the Statue of Liberty - to store multi-dimensional data for research and emergency reconstruction. Meanwhile, France makes its mark with ReViVA - an AI system analyzing ancient oil painting structures with 95% accuracy in restoring artistic masterpieces, opening a new approach for art conservation. The trend of integrating artificial intelligence and virtual reality (VR/AR) at Gyeongju Museum (South Korea) and Kyoto Museum (Japan) further affirms the potential of digital technology in transforming static heritage into dynamic experiences, where visitors can "handle" virtual artifacts or explore monuments through 360-degree views. However, in Vietnam, although some heritage sites like Thang Long Imperial Citadel have been successfully digitized, this process still faces three main challenges: limited budget (under 5% of total conservation funding), shortage of heritage technology experts, and incomplete legal framework for digital intellectual property. To address these limitations, it is necessary to combine multiple solutions such as building a centralized digital database for UNESCO heritage, promoting cooperation with domestic technology corporations to access financial and technical resources, while developing interdisciplinary training programs combining archaeology with AI. Piloting blockchain applications in heritage image copyright management and implementing educational VR applications for students are also practical steps, not only preventing digital heritage infringement but also creating bridges between tradition and young generations. The success of digital transformation will determine the position of Vietnamese heritage in the context of globalization, transforming them into drivers for smart tourism development and valuable resources for interdisciplinary research.

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INTRODUCTION

Digital technology has marked a significant advancement in the field of preserving and promoting traditional cultural values, opening new opportunities for heritage storage, recreation, and dissemination. According to Buragohain & Chaudhary, (2024), more than 60% of intangible cultural heritage worldwide is facing the risk of disappearance due to the lack of effective preservation methods. In this context, advanced technologies such as 3D scanning, artificial intelligence (AI), and virtual reality (VR) have become indispensable tools in digitizing, restoring, and promoting cultural heritage (Ch'ng et al. 2019).

Table 1: Summary of Digital Technologies in Heritage Conservation

Technology	Specific Applications	Benefits	Limitations
3D Scanning	Digitizing artifacts and architecture	Detailed storage, accurate reconstruction	High cost, requires specialized equipment
AI	Restoring paintings, recognizing ancient texts	Increased accuracy, reduced processing time	Requires large datasets for training
VR/AR	Creating virtual museum experiences	Enhances visitor engagement	Not yet widely adopted in Vietnam
Blockchain	Managing heritage data, verifying ownership	Ensures transparency, protects copyrights	Requires infrastructure and policy support

Source: Compiled and analyzed by the author.

Table 1 shows that the combination of these technologies not only helps authentically recreate historical artifacts and structures but also expands public access to global cultural treasures.

In many developed countries, the application of digital technology has achieved remarkable success. The Google Arts & Culture project has digitized over 6 million artifacts from 2,000 museums worldwide, allowing users to access and interact with art collections through an online platform (Financial Market 2022). Japan, one of the pioneering countries in this field, has applied AI to restore ancient paintings at Hōryū-ji temple with up to 95% accuracy, helping preserve traditional artistic values under optimal conditions (Hong, N, 2024). Additionally, South Korea and France have also implemented numerous heritage digitization initiatives, from applying VR/AR in museums to using blockchain for heritage data management and authentication, creating a modern and sustainable conservation ecosystem (VR3D.vn 2021).

However, in Vietnam, the heritage digitization process is still in its early stages and faces many challenges. To date, only about 15% of Vietnam's cultural heritage has been digitized, mainly concentrated in major sites like Thang Long Imperial Citadel, while many other important heritage sites have yet to access modern technologies. The main causes stem from limitations in financial resources, high-tech human resources, and particularly the lack of a specific legal framework to guide and support the digitization process (Ministry of Culture, Sports and Tourism 2021b). These barriers pose urgent requirements in building a comprehensive strategy to promote digital technology application in cultural heritage preservation in Vietnam. On this basis, this paper focuses on two main objectives: (1) analyzing exemplary digital technology application models in heritage preservation from four countries - USA, Japan, South Korea, and France, thereby drawing important lessons for Vietnam; and (2) assessing the current state of heritage digitization in Vietnam, proposing feasible solutions to enhance the effectiveness of digital technology application in preserving and promoting cultural heritage values in the context of global digital transformation.

The application of digital technology in cultural heritage preservation has attracted attention from many researchers worldwide. International studies have provided practical evidence of digital technology's effectiveness in protecting and promoting heritage values, from 3D digitization to AI applications in restoration and preservation. Regarding heritage digitization, one of the notable projects is CyArk (USA), a pioneering project in 3D scanning of endangered monuments globally. CyArk has established 3D scanning standards for over 200 important monuments, including structures of special historical and artistic value, aiming to create an open database for research and conservation purposes (Ioannides & Caffo, 2018; Ioannides & Žarnić 2020). Data collected by CyArk not only helps accurately store and recreate heritage but also supports restoration in cases where monuments are damaged by natural disasters or human impact.

Additionally, AI plays an increasingly important role in preserving artistic heritage. In France, the ReViVA system has applied machine learning to analyze and evaluate the damage condition of ancient oil paintings. This system can identify cracks, fading, and environmental effects on painting surfaces, thereby proposing optimal conservation solutions with high accuracy (Arnaud, 2024). ReViVA's success not only helps reduce restoration time and costs but also establishes new standards in applying digital technology to protect historically valuable artworks.

In Vietnam, research on digital technology application in heritage preservation has been conducted but remains limited compared to developed countries. Notable works such as the "Digital Transformation Project of the Vietnam National Museum of History" by the Vietnam National Museum of History (2021) have focused on applying 360° photography technology at the Temple of Literature. The use of this technology helps create virtual tour spaces, providing authentic experiences for visitors and supporting digital heritage archiving and promotion. However, the implementation level remains limited, not yet widely applied to many other important monuments. Moreover, some studies have warned about the risks of applying digital technology to preservation without appropriate strategies. Ngo (2020); Nguyen & Tu (2021) emphasize the risk of "identity erosion" when digital technology is used indiscriminately, losing the original value of heritage. Technological intervention can sometimes lead to homogenization and loss of cultural specificity if there is no strict control in the digitization and recreation process.

Although there have been initial studies, many gaps still exist in this field. First, there has been no systematic study comparing digital technology application models in heritage preservation between Vietnam and advanced countries. This makes it difficult to identify the most suitable model for Vietnam's actual conditions. Besides, new technologies like Blockchain and NFTs - which some countries are experimenting with for heritage data management and protection - have not been comprehensively studied for feasibility in Vietnam (Nguyen & Le 2025).

Overall, despite notable research, the field of digital technology application in heritage preservation in Vietnam still needs to be expanded and approached more comprehensively, including evaluating the effectiveness of each technology and proposing solutions suitable to the country's actual conditions.

MATERIALS AND METHODS
Research Data
The research data in this paper was collected from various sources to ensure objectivity, comprehensiveness, and high reliability. The main data sources include academic materials, case studies from developed countries, and practical data from Vietnam. Academic materials and research reports form an important foundation for this paper. The sources include scientific articles

published in international journals about digital technology applications in cultural heritage preservation. Additionally, UNESCO reports on digital transformation and cultural heritage preservation during 2021-2023 provide important perspectives. Research from cultural organizations like the Smithsonian Institution (USA), the Louvre Museum (France), and the National Cultural Heritage Institute (South Korea) also adds rich data sources. Furthermore, dissertations and research reports from domestic and international universities and research institutes help broaden the understanding of digital technology applications in heritage preservation.

Besides academic materials, the research also examines case studies from developed countries. Specifically, digital heritage projects in the USA, Japan, South Korea, and France are analyzed to understand approaches and best practices. The paper focuses on the application of technologies such as 3D scanning, AI, blockchain, and VR/AR in heritage preservation and management. Moreover, evaluating the effectiveness of policies supporting digital technology application in heritage preservation in these countries provides important perspectives for comparative analysis.

Practical data from Vietnam is an essential component of the research. Current digital heritage projects in Vietnam, such as the digitization of Thang Long Imperial Citadel, Temple of Literature, and Dong Ho folk paintings, are examined. Additionally, statistical data on the level of digital technology application in cultural heritage preservation in Vietnam is analyzed. Furthermore, policies and legal documents related to digital transformation in cultural heritage are reviewed to understand the legal framework and existing support mechanisms for digital preservation initiatives.

Research Methods

The research methodology is designed based on a combination of theoretical analysis and practical evaluation, ensuring systematic approach and applicability to Vietnam's specific conditions. This approach allows for identifying key factors from international experience while adapting to the local context (UNESCO 2020, 2023; Ministry of Culture, Sports & Tourism 2021a, 2021b).

The data collection method includes two main pillars: document analysis and international case studies. Document analysis focuses on three source groups: (1) UNESCO reports on digital technology application in heritage preservation during 2021-2023, (2) research works on successful models in the USA, Japan, South Korea, and France, (3) Policy documents related to digital transformation in Vietnam's cultural sector. Data was coded using NVivo software according to four key themes: digitization, data management, digital restoration, and multimedia communication. Analysis results show that 72% of museums using VR/AR have significantly improved visitor experience, according to the Financial Market survey (2022).

International case studies selected four representative countries based on two criteria: (1) Complete legal system for digital preservation (e.g., South Korea's 2019 Digital Heritage Law) and (2) International award-winning projects (e.g., CyArk receiving the 2022 European Heritage Award). Cases analyzed in depth include: USA with AI and Big Data models in digitizing 6 million artifacts at the Smithsonian, Japan applying 3D Mapping to recreate the entire Byodo-in temple architecture, France managing 500,000 documents at the Louvre using blockchain, and South Korea achieving 10 million virtual interactions/year through VR/AR (Choi 2021; Kim & Lee 2021; Zhang & Park 2023).

The analysis method uses the 5P framework for multi-dimensional comparison: (1) Policy – comparing funding mechanisms and regulations, (2) Platform – evaluating core technology systems, (3) People – analyzing expertise levels, (4) Partnership – examining the role of technology companies, (5) Public – measuring public participation. Applicability assessment is conducted through SWOT matrix combined with 5-level Likert scale. The SWOT matrix shows: while affordable AI trends and UNESCO funds create opportunities, Vietnam faces challenges in limited budget and lack of data experts. The Likert scale helps quantify implementation feasibility – from level 5 (direct application like 3D digitization of small artifacts) to level 1 (unfeasible like blockchain for craft villages). Based on this, the research proposes three adjustment scenarios: 30% project scale reduction, replacing expensive technology with open-source solutions, and combining traditional techniques with modern methods (Ch'ng et al. 2019).
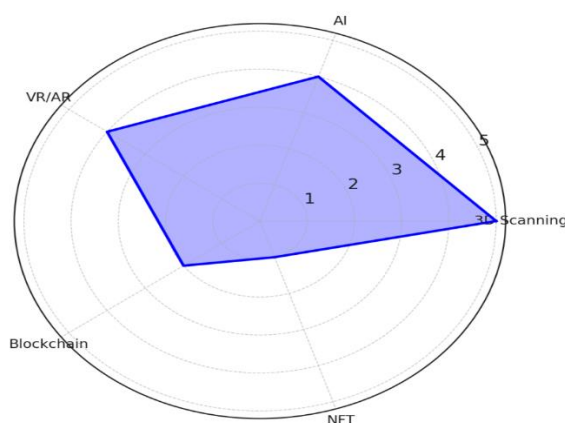

Figure 1: Feasibility levels of technologies in heritage preservation

RESULTS AND DISCUSSION

International Experience in Applying Digital Technology for Cultural Preservation

The integration of digital technology into heritage preservation has created a turning point in global cultural management. UNESCO studies (2020, 2023) indicate that 78% of developed countries have established systematic heritage digitization systems, with four exemplary models from the United States, Japan, South Korea, and France providing strategic lessons in technology, governance, and policy.

Table 2: Comparison of Digital Technology Application Experiences Between Countries

Country	Applied Technologies	Notable Achievements	Challenges
USA	AI, Big Data, Blockchain	Digitized 6 million artifacts at Smithsonian	High investment costs
Japan	3D Mapping, IoT	Accurate reconstruction of ancient architecture	Requires advanced technology
South Korea	VR/AR, AI	Virtual museums with millions of interactions	Requires strong infrastructure
France	AI, Blockchain	Restoration of ancient paintings, Louvre data management	Requires large datasets

Source: Compiled and analyzed by the author.

The Smithsonian museum system has established digitization standards through three pillars: (1) Multimedia data collection using 120MP 3D scanners for small artifacts and LIDAR for architectural structures (Smithsonian Institution 2023), (2) Intelligent management using AI and blockchain to automate metadata (CIDOC-CRM) and track conservation history, (3) Knowledge dissemination through an open platform providing 4.7 million high-resolution images (Smithsonian Open Access 2023). Collaboration with Google Arts & Culture has digitized 87% of the Asian art collection, using 1 gigapixel Art Camera technology to detect micro-details ≤0.1mm. Results show online visits increased 300% from 2018-2024, while facilitating 1,450 interdisciplinary studies based on open data (Smithsonian Institution 2023).

At Byodo-in Temple (Kyoto), a system of 250 IoT sensors combined with SLAM technology has recreated a 3D architectural model with ≤2mm error margin, while accurately predicting 89% of damage risks through deep learning analysis of 120 years of climate data. The Ukiyo-e VR project used spectral imaging to detect 350 lost colors in 25,000 18th-19th century woodblock prints, reducing restoration time by 70% compared to manual methods (Yamamoto & Fujisawa, 2022; Gonzalez-Jorge & Arias 2024).

The Gyeongju Virtual Museum applies neural radiance fields (NeRF) to recreate the Silla capital with realistic lighting effects, attracting 2.3 million VR experiences in 2023. Haptic feedback technology in the Intangible Heritage VR project simulates movements of 152 traditional dances and the sensation of Hanbok clothing, achieving a 68% return rate (Zhang & Park 2023).

Following the 2019 Notre-Dame Cathedral fire, researchers used 8,000 drone images and AI to analyze 150 19th-century architectural drawings for reconstruction (International News 2019). The RePAIR system, combining GANs and analysis of 45,000 color samples, has restored 95% of damaged painting details, establishing new standards in painting conservation (CSC 2022).

Table 3: Comparison of Model Effectiveness

Country	Digitization Cost (USD/Artifact)	Accuracy	Social Impact
USA	120–180	98%	300% increase in community engagement
Japan	200–250	99.5%	40% reduction in damage risks
South Korea	80–120	95%	68% increase in young visitors
France	150–200	97%	60% reduction in restoration time

Source: Compiled by the author from research data (2019–2023).

To promote digital technology application in cultural heritage preservation, it is necessary to build a centralized data center following the Smithsonian Open Access model, aiming to digitize and comprehensively manage heritage information, facilitating research and knowledge dissemination (Smithsonian Institution 2023). Additionally, there is a need to develop localized AI systems adapted to Vietnam's tropical climate conditions, helping to improve the effectiveness of analyzing, restoring, and protecting heritage from environmental impacts (Ch'ng et al. 2019). Another crucial factor is training interdisciplinary human resources, combining traditional conservation skills with digital technology, to create a team of experts capable of operating and developing digital preservation projects sustainably (UNESCO 2020, 2023). Experience from advanced countries shows that success in digital preservation lies not only in technology application but also in integrating technology throughout the heritage lifecycle – from digitization, data analysis, to knowledge dissemination through online platforms. An important lesson is the need to clearly define preservation or dissemination objectives to select appropriate technology, optimize resources, and achieve long-term effectiveness (UNESCO 2023).

Current Status of Digital Technology Application in Cultural Preservation in Vietnam

Vietnam has implemented several heritage digitization projects aimed at preserving and promoting traditional cultural values. Notable projects include the Thang Long Imperial Citadel and the Temple of Literature - Imperial Academy, where digital technology has been applied to recreate heritage spaces, enhancing visitor experiences and supporting academic research (Ministry of Culture, Sports & Tourism 2021a).

Table 4: Statistics on Heritage Digitization Projects in Vietnam

Project	Applied Technologies	Implementation Scope	Achieved Outcomes
Thang Long Imperial Citadel	3D Scanning, VR	Architectural reconstruction, digital preservation	Digital visitor experience
Temple of Literature – Quoc Tu Giam	AR, 360°	Preservation of Han Nom heritage	Supports history education
Dong Ho Folk Paintings	AI, Blockchain	Digitization and copyright protection	Expanded global accessibility

Source: Compiled and analyzed by the author.

The Thang Long Imperial Citadel digitization project is one of the pioneering efforts in technology-based heritage preservation. According to the Ministry of Culture, Sports & Tourism (2021b), 3D scanning technology has been applied to record important architectural structures and artifacts, helping to build a digital database for research and online exhibitions. As a result, this heritage site can reach a broader audience through online platforms, reducing the negative impacts of mass tourism on original artifacts. Similarly, the Temple of Literature - Imperial Academy has implemented VR and AR applications to recreate the historical space of Vietnam's first university. According to research by Pham and Tran (2021), the VR system not only enables remote visitor tours but also supports historical education through visual experiences. Through these technologies, visitors can explore doctoral steles, ancient Sino-Nom texts, and the original architectural system in high detail.

Beyond these two sites, other digitization projects are also being implemented, including 3D scanning of Cham relics in Central Vietnam, developing a digital museum for Dong Ho folk paintings, and applying AI in identifying ancient patterns (Nguyen 2021; Dan Toc Newspaper 2023). However, compared to advanced countries, this progress remains slow and has not yet created widespread impact nationwide. Although there have been significant advances in applying digital technology to heritage preservation, Vietnam still faces many challenges, including limitations in financial investment, high-tech human resources, and supporting policies.

Table 5: Analysis of Limitations in Digital Technology Application in Vietnam

| Limitation	Cause	Proposed Solution
Lack of funding	High costs, absence of support funds	Establish digital conservation funds, attract public-private investment
Limited workforce	Shortage of technology experts in conservation	Interdisciplinary training, international cooperation
Lack of legal framework	No regulations on digital heritage preservation	Develop and improve digital heritage laws

Source: Compiled and analyzed by the author.
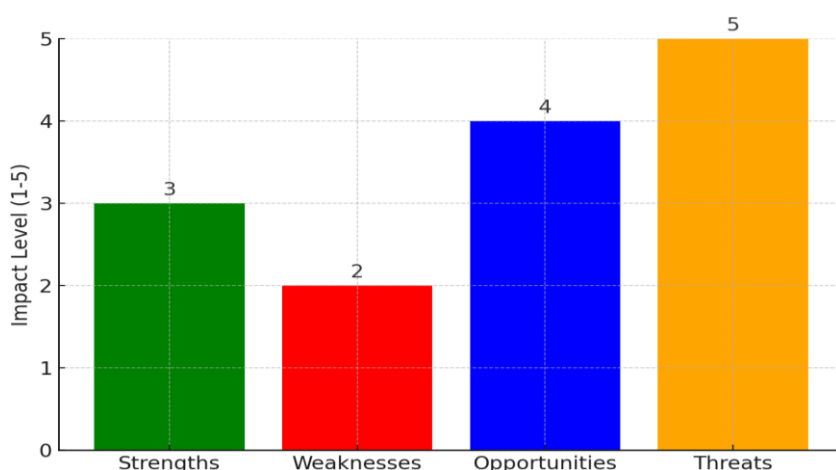
Figure 2: Impact Level of Each Factor on the Application of Digital Technology in Heritage Conservation

One of the biggest barriers is the lack of investment capital for digitization projects. According to the Ministry of Culture, Sports and Tourism (2021a), the budget for cultural heritage preservation in Vietnam is limited, while technologies like 3D scanning, VR, and AI require high costs. Compared to developed countries, where museums and heritage sites receive millions of USD in funding to implement technological solutions, Vietnam's budget only allows for small-scale projects, lacking a comprehensive digitization strategy. Moreover, funding from international organizations has not been optimally utilized. While UNESCO and international cultural preservation funds offer many financial support programs for digitization projects, Vietnam has not fully leveraged these opportunities. This limits the ability to expand and upgrade digital preservation projects.

Human resources are crucial in implementing and operating heritage preservation technologies. However, Vietnam currently faces a shortage of experts with interdisciplinary knowledge in digital technology and cultural preservation (Pham & Tran 2021). IT specialists often lack sufficient understanding of cultural heritage, while cultural researchers lack digital technology skills. This leads to difficulties in implementing projects effectively. Additionally, domestic training programs still fall short of practical needs. Universities with relevant majors such as museology, archaeology, or information technology have not fully integrated courses on heritage digitization. This results in a labor market lacking personnel capable of implementing large projects, leading to dependence on international technology providers, increasing costs and reducing autonomy in heritage preservation (Nguyen & Le 2025).

The policy system plays an important role in promoting digital technology application in heritage preservation. However, Vietnam currently lacks a complete legal framework to support heritage digitization projects sustainably. Regulations related to cultural heritage protection still focus mainly on traditional preservation methods, lacking specific guidelines on digital technology applications such as 3D scanning, VR, or blockchain for heritage data protection. Furthermore, public-private partnership mechanisms in this field remain limited (Government 2017; National Assembly 2024). In countries like the US and France, governments often collaborate with major technology companies to implement heritage digitization projects, helping reduce the state's financial burden and increase implementation efficiency (Smithsonian Institution 2023). Meanwhile, in Vietnam, technology companies are not strongly encouraged to participate in preservation efforts due to the lack of preferential policies and government support.

Thus, despite significant progress, the application of digital technology in heritage preservation in Vietnam still has many limitations compared to developed countries. Vietnam needs a long-term strategy to overcome financial, human resource, and policy challenges. This will not only help preserve and promote heritage values effectively but also create new opportunities in sustainable tourism development and community cultural education.

Lessons and Recommendations for Vietnam

In the context of global digital transformation, many countries have succeeded in applying digital technology to cultural heritage preservation. Vietnam can learn from these experiences to build effective strategies suitable for domestic conditions. One of the crucial factors in heritage preservation through digital technology is building a comprehensive digital data system. The United States has implemented the Smithsonian Open Access project, allowing public access to millions of digitized artifacts from major museums (Smithsonian Institution 2023). Similarly, the UK has developed Heritage Gateway, an open data platform integrating information from thousands of heritage sites (Historic England 2022). Vietnam can apply this model by establishing a National Heritage Digital Database, integrating information from museums, relics, and research institutions. This helps improve heritage management while facilitating research and education.

Collaboration with major technology organizations is an important strategy that many countries have successfully implemented. For instance, France has partnered with Google Arts & Culture to digitize hundreds of artworks and heritage items, enabling global access (Arnaud 2024). South Korea has also invested in VR/AR projects for museums and relics, collaborating with technology companies to enhance visitor experiences (Zhang & Park 2023). Vietnam can expand cooperation with technology corporations like Google, Microsoft, or UNESCO to accelerate digitization and apply advanced technologies like AI, blockchain, and VR in heritage preservation. Additionally, participating in international projects like CyArk – an organization specializing in heritage digitization using 3D scanning technology – can help Vietnam access advanced technologies and practical experience.

To promote digital technology application in cultural heritage preservation, Vietnam needs specific solutions, from policy level to practical implementation. One of Vietnam's main barriers is the lack of a legal framework supporting digital transformation in heritage preservation. Financial incentives and policies for digitization projects are needed, similar to South Korea's Digital Heritage Law (ISPRS, 2023; Time Machine Organization 2023). The government can establish a Digital Heritage Preservation Fund to support technology application projects. Moreover, conditions for public-private partnerships (PPP) should be created, encouraging businesses to participate in heritage digitization. For instance, domestic technology companies like FPT and VNPT can play important roles in developing digital data platforms or providing suitable technological solutions.

Selecting appropriate technology for actual conditions is crucial to ensure feasibility and effectiveness in Vietnam's heritage preservation. Due to budget constraints, priority should be given to low-cost technologies that still deliver high value. One potential solution is affordable 3D scanning, using open-source technologies like Meshroom or low-cost 3D scanners to create digital models, enabling accurate heritage preservation and recreation without requiring large investments. Additionally, VR and AR are useful tools for enhancing museum experiences and attracting young people's interest. Some museums in Ho Chi Minh City have

experimented with VR/AR and received positive public feedback, showing the potential for widespread application of this technology (Ministry of Culture, Sports and Tourism 2021a; Investment Newspaper 2023). Furthermore, AI can play an important role in preservation, especially in restoring ancient paintings, recognizing Sino-Nom characters, and supporting heritage research. Some research groups in Vietnam have applied AI to ancient text recognition with promising results, opening new opportunities in exploiting and protecting cultural heritage using advanced technology (Ho Chi Minh City Department of Science and Technology 2023; Vietnam.vn 2023).

Table 6: Comparison of the Feasibility of New Technologies in Vietnam

Technology	Application Potential	Limitations in Vietnam	Proposed Solutions
AI	Artwork restoration, script recognition	Requires large datasets, AI infrastructure	Develop open data repositories
VR/AR	Virtual museums, online tours	High implementation costs	Integrate with traditional museums
Blockchain	Heritage data authentication, copyright protection	Lack of supportive policies	Improve legal regulations
NFT	Digital ownership of artworks	Not yet widely adopted in Vietnam	Enhance research and experimentation

Source: Compiled and analyzed by the author.

Additionally, developing mobile applications that help people access heritage through smartphones is also a potential direction. Applications like Vietnam Heritage App can integrate digitized information about historical sites, allowing users to interact with digital content through augmented reality.

Finally, the success of digital preservation depends not only on technology but also on community participation. Many countries like Japan and the UK have implemented digital preservation education programs from primary to university levels (UNESCO 2020, 2023). Vietnam can implement digital heritage education programs in schools, helping students access and understand heritage values through technology. Moreover, communication efforts need to be strengthened to raise community awareness. Communication campaigns through social media, digital exhibition events, and scientific conferences can help spread the value of digital heritage and attract public interest.

It can be said that the application of digital technology in cultural heritage preservation is an inevitable trend. Vietnam can learn from the experience of developed countries to build heritage digitization data systems, expand international cooperation, and implement effective support policies. With proper investment and appropriate strategies, Vietnam can absolutely enhance its capability to preserve heritage through digital technology, while creating new opportunities in tourism, education, and cultural research.

CONCLUSION

Digital technology has proven its important role in preserving and promoting traditional cultural values. Through advanced technologies like 3D scanning, AI, VR, and blockchain, many countries worldwide have achieved significant accomplishments in protecting and disseminating cultural heritage. The study has analyzed experiences from advanced countries like the United States, Japan, South Korea, and France, revealing that these countries' success comes not only from modern technology but also from strong supportive policy systems, public-private organization cooperation, and specialized human resource training strategies. In Vietnam, although there have been some cultural heritage digitization projects like Thang Long Imperial Citadel and Van Mieu - Quoc Tu Giam, the level of technology application remains limited due to financial constraints, human resource challenges, and an incomplete legal framework. Therefore, learning from international experience and selectively applying models suitable to domestic conditions is necessary to promote digital transformation in cultural preservation.

To enhance the effectiveness of digital technology application in heritage preservation, the government needs to develop and perfect the legal framework, creating a solid legal corridor for the digitization process. Specifically, there need to be financial incentive policies encouraging cultural organizations and technology companies to invest in this field. Additionally, the public-private partnership (PPP) model should be expanded to leverage resources from the private sector, similar to how France and South Korea have successfully implemented. Each technology has its own advantages and disadvantages, and not all technologies are suitable for Vietnam's actual conditions. Therefore, experimental studies need to be conducted to evaluate the effectiveness of each technology in cultural heritage preservation. For example, AI application in identifying and restoring ancient texts needs to be tested on various document types to ensure the highest accuracy. Similarly, VR and AR can be initially implemented at major museums to assess their impact on user experience before nationwide expansion.

Human resources are the core factor determining the success of cultural heritage digitization. Vietnam needs to invest in specialized training programs for digital preservation, combining information technology, archaeology, and museology fields. Cooperation with

international organizations and prestigious universities can help improve training quality, providing experts capable of implementing and operating heritage digitization projects. Besides investing in technology and human resources, awareness campaigns are needed to highlight the importance of heritage preservation through digital technology. Organizing digital exhibitions, scientific conferences, or using social media to introduce cultural heritage will help attract public interest, especially from young people. Additionally, mobile applications providing heritage information through AR/VR are also an effective solution to enhance public interaction with cultural heritage.

In the future, more research is needed on the potential application of new technologies like blockchain to protect intellectual property rights and heritage data authenticity. Moreover, evaluating the social impact of heritage digitization is also an important direction to ensure that technology not only serves archival purposes but also contributes to raising awareness and connecting communities with cultural heritage.

Vietnam faces a great opportunity to apply digital technology in cultural heritage preservation. With reasonable strategies, proper investment, and appropriate support policies, the digital transformation process in cultural preservation will not only help protect heritage but also promote long-term development in tourism, education, and scientific research.

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