

Virtual Museum Scenarios Based on Handheld Devices as an Alternative Approach to Enhance the Preservation and Dissemination of Cultural Heritage

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Abstract

China encourages the use of technologies such as the internet, big data, and artificial intelligence to advance the digital collection, display, and utilization of cultural relic resources. The newly revised Cultural Relics Protection Law of the People's Republic of China, enacted in 2024, enshrines in law the principle of "strengthening digital efforts in cultural relic protection and promoting the digital collection, display, and dissemination of cultural relic resources." It encourages the creation of premium tourism routes based on cultural relic resources, the development of educational travel and experiential tourism, enabling the public to experience and disseminate culture through on-site engagement. Research proposes a new model for preserving and disseminating virtual cultural heritage based on the Naxi ethnic group's pictographic Dongba script, utilizing a mobile virtual museum as its core. This approach enhances immersive experiences, addresses the limitations of current designated-environment appreciation, and improves the diversity of preservation and dissemination methods. This research employs qualitative methods combined with data analysis, utilizing questionnaires to evaluate the new model's suitability through experiential assessment. It demonstrates that this mobile virtual museum-based virtual environment can serve as an alternative approach to enhance the preservation and dissemination of Dongba non-monographic characters as cultural heritage.

Keywords: Cultural Heritage, Virtual Reality, Dongba Script Non-Monographic Characters

1 Introduction

In recent years, with China's increasing emphasis on cultural heritage, the cultural heritage economy has emerged as a rising sector, becoming a new calling card for China and a significant driver of economic growth. Statistics indicate that funding for cultural heritage preservation in China has continued to rise, with 2022 seeing an increase compared to 2021, supporting thousands of cultural heritage conservation projects. According to reports from institutions such as Tsinghua University's Institute of Cultural Economics, the market size for cultural heritage-themed creative products in Chinese museums has surpassed ten billion yuan. The Palace Museum, the National Museum of China, and the Dunhuang Academy are leading the charge, with top museums achieving annual cultural and creative sales ranging from hundreds of millions to over a billion yuan. For instance, the Palace Museum's cultural and creative products reached an annual revenue of 1.5 billion yuan during their peak period (around 2017).

According to China's 'Cultural Heritage Dissemination Strategy,' the dissemination of cultural heritage in China has historically been limited in scope, with low public awareness, indicating significant challenges in its communication. This limited dissemination stems from restrictive reach, monotonous methods, and low utilization rates, largely due to historical emphasis on artefact excavation, physical museums, and tangible exhibitions. Consequently, researchers propose integrating virtual technologies with cultural heritage to explore whether virtual reality can pioneer novel dissemination models for non-monographic cultural heritage like the Dongba script [1, 2].

The Naxi ethnic minority of China is regarded as descendants of the ancient Jiang people of Northwest China. Dongba script represents their primitive civilization, encompassing systematic scriptures, dance, monumental scrolls, and music. This study, grounded in the non-monographic nature of Naxi Dongba script as Chinese cultural heritage, proposes integrating virtual technology with non-monographic Dongba script to pioneer new approaches for cultural heritage preservation and rapid dissemination.

2 Research Significance

The Naxi Dongba script can be categorized into single-character and non-single-character components. Researchers utilize non-single-character elements as a focal point, integrating virtual reality technology to enhance their preservation and widespread dissemination. This novel dissemination model enables scholars and readers to accurately comprehend the morphological characteristics of non-single-character Naxi Dongba script, recognize the cultural heritage significance of these non-single-character components within the script, and achieve the dual objectives of cultural heritage preservation and rapid dissemination. This constitutes the primary significance and purpose of this research.

3 Research Status

The latest study, Liang et. al [2], proposes cultural heritage dissemination centered on virtual reality (VR) technology. This research identifies virtual museum dissemination, enhancing immersive cultural experiences. 'Research on the Impact of Online Marketing on the Consumer Purchase Intent of

Museum Cultural Creative Products' [3] addresses the development of cultural heritage on the internet [4, 5].

Researchers adopted a non-single-character approach to the Naxi Dongba script, drawing upon the virtual museum concept from 'Virtual Reconstruction of a New Model of Cultural Heritage Dissemination' and the internet development perspective from 'Research on the Impact of Online Marketing on the Consumer Purchase Intent of Museum Cultural Creative Products'.

Proposing a novel research direction: virtual scenarios based on handheld virtual museums, unrestricted by time and space, enabling efficient global dissemination of virtualized cultural heritage. This delivers immersive experiences, realizing a new model for preserving and rapidly disseminating Dongba script non-monogram characters. [6–8]

Zhang and Huang (2024) [9] demonstrates that applying virtual reality technology to assist physical fitness training in higher education enables learners to engage in real-time sensory interactions through VR sensor equipment within simulated exercise scenarios. Experimental findings indicate that optimizing student physical training through virtual reality technology is meaningful, with research demonstrating the technology's potential for sustained implementation. Drawing upon this, the present study similarly employs virtual technology, utilizing a virtual museum framework to demonstrate that the virtual preservation and dissemination model for cultural heritage offers sustainable applicability. Experimental findings reveal positive expectations and satisfaction among participants, confirming that the virtual museum platform enables non-monolithic virtual preservation and rapid dissemination of Dongba script. This approach, realized through a mobile virtual museum, demonstrates sustainable applicability.

4 Challenges and Innovations

A. Key Issue, Primary Challenge and Approach

Disseminating non-single-character elements of the Naxi Dongba script, a Chinese cultural heritage. Methods and formats for dissemination. Integrating contemporary digital media and virtual technologies, this research pioneers a new interactive model for preserving and disseminating virtual cultural heritage through public exhibitions centered on the Dongba script's non-monographic nature. This constitutes the primary focus and challenge. Phase one introduces scalability to enhance the cultural heritage's gamification (refer Fig. 1 and 2). Phase two establishes a handheld virtual museum collection, promoting long-term preservation of cultural heritage while accelerating dissemination. (refer Fig. 3)

B. Rationale and Basis

The 2022 '14th Five-Year Plan for Cultural Development' emphasizes strengthening cultural relics science and technology innovation: utilizing digital technology to empower cultural relics conservation and display, advancing museum reform and development, enhancing exhibition quality, developing smart museums, and promoting deep integration of culture and tourism. This approach shapes tourism through culture and highlights culture through tourism, making cultural heritage the core attraction of tourism.

C. Recommendation

Advance knowledge innovation in relevant fields. The Naxi Dongba script, being non-alphabetic, enables the construction of new models for cultural heritage preservation and dissemination through virtual reality technology. This represents not only innovation within the museum sector but also a highly interconnected 'cultural-technological' engine capable of effectively driving development across multiple domains:

D. Core Domain

Within the framework of academic research on cultural-technology integration, this core domain explores dual pathways to realize the synergistic development of heritage conservation and creative industry innovation. On one hand, it advances the disciplinary construction of cultural heritage protection combined with digital technologies by fostering the emerging fields of "digital archaeology" and "virtual restoration"; specifically, non-invasive research methods including site evolution simulation, virtual scene reconstruction and cultural relic color restoration are carried out in virtual environments, which not only breaks through the limitations of traditional heritage research methods but also expands the theoretical and practical boundaries of artistic research methodologies. On the other hand, targeting the development of the immersive content creative industry, this domain takes the unique cultural symbols (such as ancient scripts and totems) contained in the non-monographic Naxi Dongba script system as the core creative resource, and promotes the incubation of localized cultural-technology IP through the creation of serialized, high-quality original VR/AR content, thereby providing a feasible academic paradigm for the transformation of intangible cultural heritage resources into high-value cultural products [10].

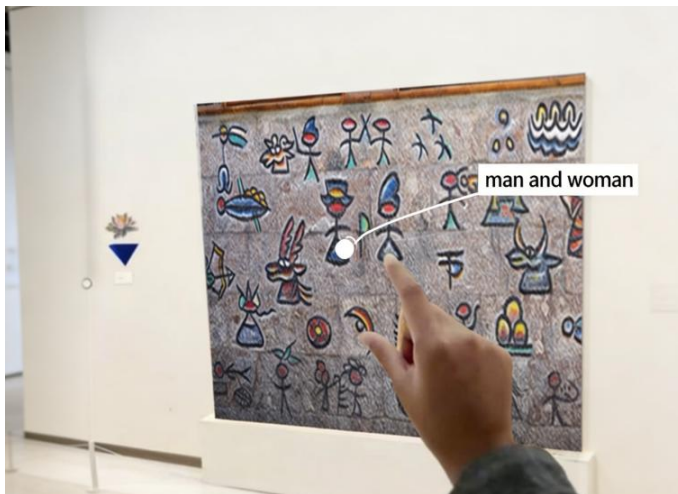


Fig. 1 Virtual Zoom



Fig. 2 Virtual zoom

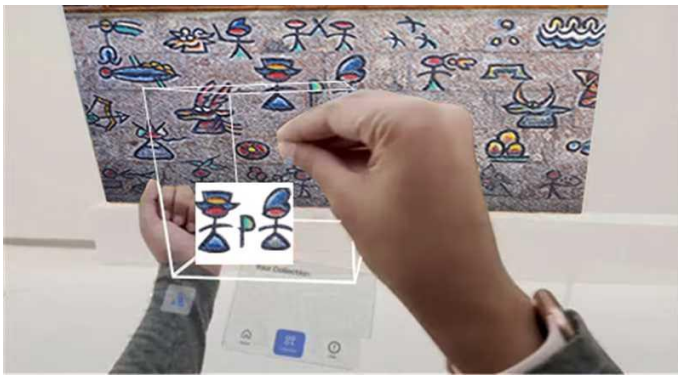


Fig. 3 Collection of the virtual museum in the palm of your hand

5 Materials and Methods

The objective of this study is to develop a non-monographic Dongba script virtualization technique for a handheld virtual museum, thereby enhancing the long-term playability, preservation, and rapid dissemination of cultural heritage. To this end, the following investigation was designed.

The investigation commenced with participant recruitment, restricted by age and region. It was explicitly stated that this study would not require participants' names or work affiliations, that all responses would be strictly confidential, and that data would be used solely for the article. Participation was entirely voluntary. Recruitment Channel: Online via Xiaohongshu APP. Employing qualitative research and literature review to comprehend the distinctiveness of Naxi Dongba script, its pronunciation, and local Dongba pictorial art, the researcher conducted face-to-face interviews with Naxi elders in Lijiang, Yunnan, China, utilizing field interview techniques. This approach necessitates direct interaction between interviewer and interviewee, enabling researchers to observe the interview setting, facial expressions, and attitudes of participants. It also ensures the quality of responses, reduces the likelihood of misunderstanding questions, and enhances research accuracy. Below is the User Experience Evaluation Form (see Table 1).

Table 1. Questionnaire for Evaluating AR Immersive Experiences in Virtual Environments

Question	Agree (%)	Uncertain (%)	Disagree (%)
AR animation museum helps you to learn more about Dongba script non-monogram	94	4	2
AR animation combined with the interesting evolution of the Dongba script appeals to you	92	6	2
AR animation museum under the Dongba script non-monogram can let you better understand the cultural heritage	95	4	1
AR animation museum have enhanced effect on promotion of non-monogram cultural heritage of Dongba script	90	8	2

The above data survey indicates that the majority agree virtual reality AR animation promotes the preservation and dissemination of Dongba script non-monographic cultural heritage. The lowest agreement rate among respondents reached 90%, with over 90% believing virtual technology positively impacts Dongba script non-monographic preservation. Uncertain responses accounted for 4% or 6%, while opposing views constituted 1% or 2%. These findings confirm widespread recognition of the novel approach—combining Dongba non-character elements with virtual technology to establish a mobile virtual museum—for achieving virtual preservation and rapid dissemination of Dongba non-character elements, demonstrating its potential for broader implementation. Subsequent interviews revealed that opposing views stemmed primarily from two concerns: a minority of users felt that purely animated virtual modes diminished the tangible, two-way interaction between the museum and visitors, while others expressed a desire to strengthen emotional connections with non-single Dongba characters. Consequently, these research findings will lay the groundwork for subsequent development of virtual human intelligence applications.

6 Conclusion

Systematic Advancement from “Heritage Site” to “Platform”. The primary objective and significance of this research lies in realizing a novel dissemination model: the preservation and rapid dissemination of virtual museums via mobile devices through “Virtual Reality Combined with Dongba Script Non-Monographic Characters”. Its contribution value stems from transforming it from a physical cultural heritage protection unit into a functional “Cultural Science and Technology Innovation Platform”. Internally, this platform serves as a hub connecting conservation, research, education, tourism, and creative industries, facilitating cross-sectoral flow. Externally, it functions as a showcase for China's cultural heritage and civilization, exemplifying the nation's application of cutting-edge technology to safeguard and perpetuate its cultural legacy. The success of this novel model not only enables the digital rebirth of cultural heritage within cyberspace but also systematically drives the coordinated development of regional cultural economies, related industrial clusters, and contemporary cultural confidence.

DECLARATIONS

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