

Digital Humanities-Based Protection of Ethnic History and Cultural Heritage

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Abstract: The protection of ethnic history and cultural heritage is crucial for maintaining cultural diversity and national identity, yet it faces challenges such as fragmented heritage resources, difficult preservation of intangible elements, and limited public accessibility. This study aims to explore the application path and effectiveness of digital humanities in addressing these challenges. Methods including literature metrology analysis, case study, and technical integration research are adopted. The research process first combs the theoretical system of digital humanities and the current situation of ethnic heritage protection; then constructs a digital protection framework integrating technologies such as 3D modeling, GIS spatial analysis, and semantic annotation; subsequently verifies the framework through typical cases of ethnic heritage protection at home and abroad; and finally summarizes the application effect and optimization direction. The results show that digital humanities can effectively realize the digitization, integration, and visualization of ethnic history and cultural heritage, improve the efficiency and sustainability of protection work, and promote the inheritance and dissemination of ethnic culture. This study provides theoretical support and practical reference for the modernization transformation of ethnic heritage protection.

Keywords: Digital Humanities; Ethnic History and Cultural Heritage; Heritage Digitization; Digital Conservation; Case Study

1. Introduction

1.1 Research Background and Significance

Ethnic history and cultural heritage, as the carrier of a nation's memory and the embodiment of cultural diversity, are facing severe challenges amid rapid urbanization and

globalization. The degradation of tangible heritage sites, the loss of intangible cultural heritage such as oral traditions and traditional crafts, and the fragmentation of heritage resources have become prominent issues restricting the inheritance and development of ethnic cultures. In this context, the digital transformation of heritage protection has become an inevitable trend in the global cultural heritage field. Digital humanities, which integrates information technology, computer science and humanities research, provides a new technical means and theoretical perspective for solving the bottlenecks in traditional ethnic heritage protection. Exploring the application of digital humanities in ethnic history and cultural heritage protection is not only conducive to realizing the permanent preservation and efficient utilization of heritage resources, but also promotes the innovative dissemination of ethnic cultures and enhances the recognition and identity of ethnic cultures. This research also responds to the global call for the protection of cultural diversity and provides a Chinese practice paradigm for the digital transformation of cultural heritage protection.

1.2 Review of Domestic and Foreign Research Status

Foreign research on digital humanities and cultural heritage protection started earlier. Scholars have carried out in-depth explorations in the digital collection, virtual restoration and interactive display of cultural heritage. Typical cases include the 3D digital reconstruction of the Colosseum in Italy and the digital archiving project of ancient Egyptian cultural relics. These studies have formed a relatively mature theoretical system and technical framework, focusing on the integration of advanced technologies and heritage protection. However, foreign research focuses more on Western cultural heritage, and there is a lack of targeted research on the characteristics of ethnic heritage in multi-ethnic countries. Domestic research on

digital humanities and ethnic heritage protection has developed rapidly in recent years, with a large number of studies focusing on the digital protection of specific ethnic groups such as Tibet, Yi and Miao. Relevant research has achieved results in the digital collection of ethnic cultural relics and the construction of digital exhibition halls. However, there are still obvious deficiencies in the current domestic research: the application of digital humanities technology is relatively fragmented, lacking a systematic protection framework; the integration of theoretical research and practical application is insufficient, and the effectiveness of technical application needs to be further verified; the research on the long-term operation mechanism and risk prevention of digital protection is relatively scarce. Therefore, based on the summary of domestic and foreign research, this paper constructs a systematic digital protection framework for ethnic heritage, which has important theoretical and practical significance for filling the research gap and promoting the modernization of ethnic heritage protection.

2. Relevant Theoretical Basis

2.1 Core Theory and Technology System of Digital Humanities

The core theories of digital humanities include computational humanities, data-intensive research and digital hermeneutics. Computational humanities uses computational methods to analyze and interpret humanistic data, realizing the transformation of humanistic research from qualitative analysis to quantitative and qualitative combination. Data-intensive research takes large-scale humanistic data as the core, emphasizing the acquisition, processing and mining of data to discover potential laws and connotations in humanistic research. Digital hermeneutics focuses on the interpretation of digital texts and digital images, ensuring the authenticity and depth of humanistic research in the digital environment. The technical system of digital humanities mainly includes data acquisition technology, data processing technology, data visualization technology and interactive technology. Data acquisition technology covers 3D laser scanning, multi-spectral imaging, high-resolution photography and other technologies, which can realize the accurate collection of tangible and intangible heritage information. Data processing

technology includes data cleaning, semantic annotation, metadata construction and other technologies, which lay the foundation for the effective utilization of heritage data. Data visualization technology such as GIS spatial analysis, virtual reality (VR) and augmented reality (AR) can present heritage information in an intuitive way. Interactive technology realizes the two-way communication between the public and heritage resources, enhancing the participation and experience of the public.

2.2 Theoretical Connotation of Ethnic History and Cultural Heritage Protection

The protection of ethnic history and cultural heritage adheres to the core principles of authenticity, integrity and living inheritance. Authenticity requires that the original appearance and historical connotation of heritage be preserved in the process of protection, avoiding arbitrary modification and distortion. Integrity emphasizes that the protection of heritage should cover not only the heritage itself, but also its surrounding environment and related cultural contexts. Living inheritance focuses on the inheritance of intangible cultural heritage, emphasizing the role of inheritors and the integration of heritage into modern life. The theoretical connotation of ethnic heritage protection also includes the concept of sustainable development, which requires balancing the relationship between heritage protection and economic development, ensuring that heritage resources can be passed on to future generations. In addition, the protection of ethnic heritage also involves interdisciplinary theories such as cultural anthropology, folklore and archaeology. These theories provide a theoretical basis for understanding the cultural connotation of ethnic heritage and formulating scientific protection strategies.

3. Application Practice of Digital Humanities in the Protection of Ethnic History and Cultural Heritage

3.1 Application of Digital Collection and Collation Technology for Ethnic Heritage

Digital collection is the basis of digital protection of ethnic heritage, and different collection technologies are selected according to the type and characteristics of heritage. For tangible heritage such as ethnic buildings and cultural relics, 3D laser scanning technology is

used to collect spatial information with high precision. This technology can quickly obtain the three-dimensional coordinates of the heritage surface, with an error range of less than 0.1mm, ensuring the accuracy of digital modeling. For intangible heritage such as ethnic costumes and handicrafts, multi-spectral imaging technology is used to collect color information and material characteristics, which can present the details of heritage that are not visible to the naked eye. For oral traditions such as ethnic ballads and myths, high-fidelity audio and video collection

equipment is used to record, and speech recognition technology is used to convert audio information into text for storage and retrieval. After collection, the heritage data needs to be collated, including data cleaning, deduplication and classification. Semantic annotation technology is used to add descriptive information to the data, establishing the association between data and realizing the effective management of data. Table 1 shows the comparison of different digital collection technologies for ethnic heritage.

Table 1. Comparison of Digital Collection Technologies for Ethnic Heritage

Technology Type	Application Scope	Accuracy	Advantages	Disadvantages
3D Laser Scanning	Ethnic buildings, large cultural relics	$\leq 0.1\text{mm}$	High precision, fast collection speed	High equipment cost, complex post-processing
Multi-spectral Imaging	Ethnic handicrafts	Color resolution $\geq 48\text{ bits}$	Can show hidden details	Strict environmental requirements
High-fidelity Audio-Visual Collection	Oral traditions, performances	$\geq 48\text{kHz}$	True audio sampling rate	True reproduction of on-site effects Affected by ambient noise

3.2 Practice of Integration and Display of Ethnic Heritage Based on Digital Humanities

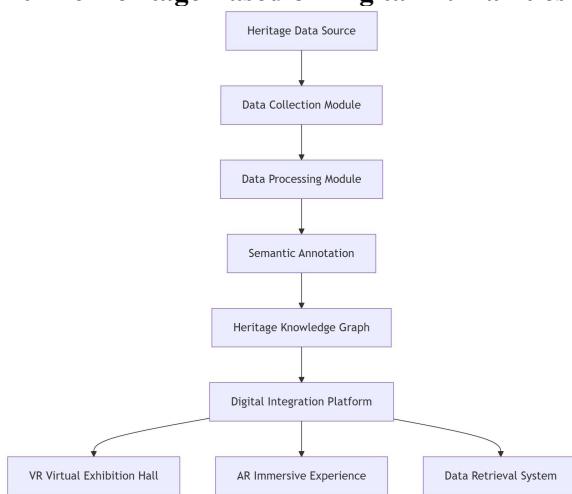


Figure 1. Framework of Ethnic Heritage Digital Integration and Display Platform

The integration of ethnic heritage based on digital humanities is to establish a unified digital platform to integrate scattered heritage data. The platform uses database technology to store various types of heritage data, and uses semantic web technology to establish the association between different types of data, forming a structured heritage knowledge graph. This knowledge graph can realize the cross of heritage data, helping researchers and the public to comprehensively understand the cultural connotation of ethnic heritage. In terms of display, VR/AR technology is used to create virtual exhibition halls and immersive experience scenes. The public can visit the virtual exhibition hall through mobile devices or

VR equipment, and interact with virtual heritage resources. For example, through AR technology, the virtual restoration scene of ethnic ancient villages can be superimposed on the real environment, allowing the public to intuitively feel the historical style of the village. Figure 1 shows the framework of the ethnic heritage digital integration and display platform.

4. Challenges and Optimization Paths of Digital Humanities-Driven Ethnic Heritage Protection

4.1 Core Challenges in Practice (Technology Adaptation, Data Security, etc.)

Despite the remarkable results of digital humanities in the protection of ethnic heritage, there are still many challenges in practical application. In terms of technology adaptation, the existing digital humanities technologies are mostly developed for Western cultural heritage, and there is a lack of adaptability to the characteristics of ethnic heritage in China. For example, the shape and structure of ethnic buildings are complex, and the existing 3D modeling technology has difficulties in accurate modeling. In terms of data security, the digital data of ethnic heritage involves important cultural information, and there are risks of data leakage, tampering and loss in the process of storage and transmission. At the same time, the long-term preservation of digital data is also a major challenge, as digital storage media have a limited service life and data formats may become obsolete. In addition, the lack of

professional talents is also a prominent problem. The digital protection of ethnic heritage requires interdisciplinary talents who master both digital technology and ethnic culture, and the current talent reserve in this field is insufficient. The high cost of digital protection is also a factor restricting the popularization of the technology, especially for underdeveloped areas with rich ethnic heritage resources.

4.2 Targeted Optimization Strategies and Development Suggestions

To address the above challenges, targeted optimization strategies are proposed. In terms of technology adaptation, it is necessary to carry out customized development of digital humanities technologies according to the characteristics of ethnic heritage. For example, develop a 3D modeling algorithm suitable for complex ethnic buildings, improving modeling accuracy and efficiency. In terms of data security, a multi-level data security protection system should be established, including data encryption, access control and backup recovery. At the same time, formulate relevant laws and regulations to standardize the management and use of heritage digital data. In terms of talent training, strengthen the interdisciplinary construction of universities and research institutions, set up professional courses related to digital humanities and ethnic heritage protection, and cultivate compound talents. In terms of funding guarantee, establish a diversified funding mechanism, integrate government financial investment, social capital and international cooperation funds, and provide financial support for the digital protection of ethnic heritage. In addition, strengthen international exchanges and cooperation, learn from advanced foreign experience, and promote the innovation and development of digital protection technology.

5. Conclusion

5.1 Main Research Conclusions

This paper explores the application of digital humanities in the protection of ethnic history and cultural heritage, and draws the following main conclusions: First, digital humanities provides a new technical means and theoretical perspective for the protection of ethnic heritage, which can effectively solve the problems of traditional protection methods such as low efficiency and

poor sustainability. Second, the constructed digital protection framework integrating data collection, processing, integration and display can realize the systematic protection of ethnic heritage. Third, the application of digital humanities technology can improve the accessibility and utilization efficiency of ethnic heritage resources, promoting the inheritance and dissemination of ethnic culture. Fourth, the digital protection of ethnic heritage faces challenges such as technology adaptation, data security and talent shortage, which need to be addressed through targeted strategies.

5.2 Research Limitations and Future Prospects

This study also has certain limitations. The research focuses on the overall framework and technical application, and the in-depth research on the digital protection of specific ethnic groups is insufficient. At the same time, the effectiveness of the constructed digital protection framework needs to be further verified through more practical cases. In the future, the research can be expanded in the following aspects: first, carry out in-depth case studies on the digital protection of specific ethnic groups, and summarize targeted protection experience; second, strengthen the research on the long-term operation mechanism of digital protection, ensuring the sustainable development of digital protection projects; third, explore the application of emerging technologies such as artificial intelligence and big data in ethnic heritage protection, further improving the level of digital protection; fourth, strengthen international cooperation, promote the exchange and sharing of ethnic heritage digital resources, and contribute to the protection of global cultural diversity.

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