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Application of Metadata and Blockchain Technology in the Digital Preservation of Ethnic Music Resources

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Abstract:
Ethnic music is a key component of China's traditional culture, reflecting the creative achievements of the people and rich cultural values. In the context of the national cultural digitalization strategy, the digital preservation and transmission of ethnic music is crucial for strengthening cultural self-confidence and inheriting national traditions. This paper examines the application of digital technologies in ethnic music preservation, focusing on the integration of metadata management and blockchain technology. It provides strategic recommendations for the digital preservation and sustainable inheritance of ethnic music resources.

Keywords:
Digital preservation, ethnic music, metadata management, blockchain technology

1Introduction

Ethnic music has different positions and roles in various cultures. First, it is an important carrier of national culture inheritance, recording folk stories, folk customs, social customs and so on through the form of ethnic music. For example, (Huang & Zhang, 2019) the “Wall-laying Song” of the Tibetan masses is a record of the wall-laying activities of the Tibetan masses. This music not only records the former labor activities but also helps future generations to understand the cultural roots of their people. Second, traditional ethnic music plays a unique role in education; it is not only a part of music education but is also often integrated into the dissemination of morals and the guidance of values. It serves as a means of education that integrates children and promotes their language learning and understanding of social civilization and cultural construction. For example (Zhai, 2024), when teaching the lesson of Mongolian song“Silver Cup”, we can start from the Mongolian diet, dress, customs and other aspects of the classroom knowledge content of the introductory link, broaden the students’ understanding of Mongolian ethnic culture, and then deepen into the study of music culture, to cultivate a wider range of student’ musical and cultural horizons. In addition, ethnic music plays an important role in social activities. Whether it is festival celebrations, weddings and funerals or other social ceremonies, music plays an important role as an important part of them. It injects fresh vigor and vitality into social ceremonies through singing and dancing accompaniment, instrumental performance, and ethnic music

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rapping, etc. It also symbolizes the regional characteristics and distinctive national character of some ethnic groups. They also symbolize the regional characteristics and distinctive national character of some ethnic groups, highlight the cohesion of regional culture, and provide an emotional outlet for other participants in social activities. For example, in China, some ethnic music is often combined with traditional festivals to pave the way for the festivities. For example, during the Day of the Dead, rich musical celebrations are held throughout Mexico, with people playing traditional folk instruments, such as guitars and marimbas, and singing traditional songs of the dead as a way of memorializing family and friends.

Ethnic music is a record of the true portrayal of folk people's production and life and contains rich ethnic genes. Under the background of the national cultural digital strategy, the use of modern information technology means to systematically collect, organize and data process the originally dispersed and messy cultural archives of ethnic music, to strengthen the protection and utilization of ethnic music, which is of great strategic significance for the inheritance of ethnic music and the promotion of folk culture. Ethnic music carries the cultural roots of the Chinese nation; it carries the record of the culture of a region; and it carries the deep emotions of the children of all Chinese nationalities. With the rapid development of the world's economy and culture, the increasing trend of globalization of culture, the accelerated development of mass media, and the change and transformation of people's access to cultural knowledge, the existence space of ethnic music is forced to make corresponding adjustments and transformations. Undoubtedly, digitization is exactly what the public demands in the face of the above trends. Only in this way can the excellent traditional cultural genes of our nation survive for a longer period, and their charms become more brilliant with the passage of time.

2 Literature Review

2.1 Inheritance Dilemma and Digital Preservation of Ethnic Music

In the dilemma of heritage and development path construction faced by ethnic music, Shi (2015) analyzes the dilemma of ethnic minority original music from the perspective of ethnic culture protection and inheritance and puts forward the proposal of heritage of ethnic original music based on modern life. Liu (2013) introduces the success of the Yunnan Arts Institute in establishing the "Precious Historical Audio Digitization Restoration and Protection Laboratory" in 2011, and Zhang (2024) uses traditional Chinese ethnic music and bamboo flute music as a starting point to rescue, protect, excavate and organize ethnic minority art and culture. Liu (2013) describes the Yunnan Arts Institute's establishment of the"Precious Historical Audio Digital Restoration and Protection Laboratory" in 2011 to rescue, protect, excavate, and organize ethnic minority art and culture, which has achieved a stage-by-stage success. Zhang (2024) takes traditional Chinese ethnic music and bamboo flute music as an entry point and applies digital technology to promote traditional Chinese ethnic music and preserves and disseminates bamboo flute music by using digital platforms, such as Internet archives and You Tube, so that it overcomes the obstacles of traditional preservation. It makes it possible to overcome the obstacles of traditional preservation and realize the preservation and dissemination of ancient customs in a digital environment. The core of digital preservation of ethnomusicology lies in the use of modern technological means to transform ethnomusicology's timbre, musical scores and other related material information into a digital form. Teng (2020) points out that digital information preservation is in the form of a network disk, which saves the financial and human costs of ethnomusicology cultural preservation. For exam-

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ple, the“Chinese Traditional Instrumental Music Digital Preservation Project” of the China National Academy of Art digitally restores cultural relic ethnic musical instruments through high-precision timbre acquisition and reconstruction technology, so that they can be revived in the digital music world. In addition, the “Memory of the World-Chinese ethnic music Recording Archives” digital platform and application developed by the university also provide important support for the digital rescue and preservation of ethnic music recording archives. Of course, digital preservation is not only about changes in form, but also the maintenance of connotations. as Ye (2024) states, both traditional and digital cultures innovate while preserving their uniqueness and connotations. These innovations aim to meet contemporary society’s cultural needs and foster its development. Di et al. (2012) argues that the creation of digital platforms allows listeners from different backgrounds to (2012) argue that the creation of digital platforms allows listeners from different backgrounds to listen to concerts, instrumental works and historical music, and that digital archives allow for the preservation and transmission of these oral traditions, which have been handed down from one generation to the next.

2.2 From metadata to blockchain: technology and copyright issues in the digital preservation of ethnic music

The management of metadata plays a crucial role in the digitization process of ethnic music. Metadata provides detailed categorization information for music materials, such as music genre, performance form, regional style and creation age. Through these classification annotations, a large number of dispersed music materials can be systematically categorized into a well-organized organizational structure, thus facilitating users to quickly locate and browse the desired music.Formenton et al. (2017) point out that long-term digital preservation can only be guaranteed through the effective implementation of metadata standards, which play a role in the description, consistency, and interoperability of digital resources in the information environment, persistence and interoperability play a crucial role. For example, the Library of Congress’ audio preservation program employs detailed metadata standards, with each recording containing metadata components for descriptive, administrative, and technical information (Wei, 2020). This practice not only contributes to the preservation of sound quality but also ensures the integrity and retrievability of the information. However, the challenges of digitally preserving ethnomusicology have become more complex with the continuous advancement of digitization technology and the widespread use of big data. Nowadays, it is increasingly easy for the public to use all kinds of copyrighted music, but this also raises more challenges in copyright protection. Digitization is not only a means of cultural heritage preservation, but it has also led to a dramatic shift in the way information is disseminated, stored and preserved. At the same time, the digital preservation of ethnic music also faces great challenges in copyright protection, and how to carry out effective copyright management and protection has become a key issue in the process of digital preservation. In solving the problem of copyright protection, the application of blockchain technology has gradually become an effective solution. According to De et al. (2016), the core role of music copyright is to safeguard the rights of creators by allowing them to exclude competitors and the public from accessing and copying their works, thus providing sufficient incentives to compensate for the investment in the creative process. In recent years, blockchain technology has gained widespread attention in music copyright protection due to its untamable and decentralized features. Wei (2020) points out that blockchain technology, as a kind of distributed database, achieves persistence and security of information by maintaining an ever-growing chain of data. Huang (2019) further explains that, when a transfer of copyrights occurs, the new transaction is the entire network after broadcasting, and the nodes

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selected by the consensus mechanism timestamp the new block and add it to the blockchain, thus ensuring the transparency and tamper ability of the copyright transaction. This provides a reliable means of copyright protection for digitized traditional ethnic music. Not only that, Sun (2024) emphasizes that the advantages of blockchain technology in mainstream media copyright protection cannot be ignored. It ensures clear traceability of originality and ownership, which enhances the accuracy and efficiency of rights enforcement; at the same time, it also enables real-time monitoring and tracking of infringing behaviors, providing support for rights defense. Through the non-tamper able characteristics of blockchain, cross-regional and cross-platform collaboration on rights defense becomes more efficient and secure. The advantages of blockchain technology are obvious, but it is also necessary to pay attention to the scope of application of the technology and the difficulty of implementation. However, in the process of digitally preserving traditional ethnic music, over-reliance on a particular technology may also pose potential risks. For example, over-reliance on a particular digital technology for audio storage and access may result in loss of or inaccessibility to materials once the technology becomes obsolete or inoperable. In addition, current digital preservation technologies tend to focus on external forms such as audio and symbols, while the depth of cultural connotations is not yet sufficient. Ye (2024) points out that although digital preservation can help the dissemination of cultural heritage, it also brings problems such as information distortion and piracy, which threaten the uniqueness and integrity of cultural heritage. Therefore, digital preservation should not only focus on technical means, but also on the communication and protection of cultural connotations. Overall, digital preservation of traditional ethnic music is not only a technical challenge, but also a complex task of cultural protection. In this process, the role of public policy is particularly important. According to Wang (2022), public policy should help the public establish a correct awareness of copyright by strengthening copyright law and copyright education, thus enhancing the protection of music creators' rights. This process not only relies on technological innovation but also requires the joint efforts of all musicians to create a better and safer environment for the digital preservation of ethnic music, to ensure the long-lasting inheritance and sustainable development of traditional ethnic music. Summarizing the above literature, although many studies have explored the digital preservation methods of traditional ethnic music, there is a lack of literature related to the combination of digital technology and blockchain applied to the preservation of traditional ethnic music. Therefore, this study aims to fill the gap in this field, explore the innovative path of combining digitization with blockchain technology, and provide new solutions for the digital preservation of traditional ethnic music.

3 Research Method

The proposed technical overview focuses on the specific application of harvested audio, metadata and blockchain in the digital preservation of Chinese ethnic music, through in-depth analysis and careful design, to solve the difficulties in the combination of metadata and blockchain, and to provide new ideas for the preservation and development of ethnic music.

3.1 Technology overview and technology framework

This study focuses on the digital preservation of ethnic music, specifically covering two major areas: audio and sheet music. First, around score preservation, paper scores are converted into electronic format through the application of scanning and optical music recognition (OMR) technologies to facilitate their digital dis-

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semination, and corresponding online linking columns are set up to support access and learning by educators and musicians. Secondly, in terms of audio preservation, optimized preservation of audio quality is ensured through live recording using high-quality recording equipment, and necessary restoration and recovery of existing historical audio materials. Adobe software plays a key role in post-production and editing to safeguard the aural quality of the audio. In addition, the core technology of this research lies in the construction of a secure and reliable digital platform using metadata standardization and blockchain technology. Detailed records of metadata include track names, singers, transmitters, regional and ethnic information, music duration and format, etc. The organization of content and retrieval efficiency are enhanced through the standardization of these metadata. In addition, semantic expansion of metadata is crucial to dig deeper and present the culture and background of ethnic music to enhance users' awareness and interest. To ensure efficient and reliable data preservation, a decentralized storage method (IPFS) is used, and the metadata and actual audio files are linked via hashes on the blockchain to ensure file consistency and tamper-proofing. Blockchain is also used for music copyright protection, where each uploaded music will generate a timestamp on the blockchain, effectively tracking and protecting the originality of the work and reducing copyright disputes. In summary, through the application of metadata and blockchain technology, not only does it provide strong technical support for the digital preservation of ethnic music, but it also opens a new way of music protection and inheritance, which contributes to its long-term development and popularization. They greatly facilitate access and use by musicians, educators and researchers, while enriching the public's understanding of and interest in ethnic music.

3.2 Innovative points

Combining the use of metadata and blockchain technology for the digitization of ethnic music: This research is the first time that metadata and blockchain are applied to the digital preservation and inheritance of ethnic music. By building a virtual digital online platform, visitors can access the original, first-hand or nearly first-hand traditional ethnic music materials at a low cost and feel the true art form and the charm of the ethnic music in a more efficient way. This innovative combination provides new ideas for the preservation of ethnic music and opens a new paradigm for the protection of excellent ethnic music.

Advanced scanning technology and optical recognition technology (OMR) provide convenience for the music score type preservation, which makes it more convenient for users to receive first-hand score resources, learn and utilize the first-hand resources, which promotes users' understanding of ethnic music and indirectly facilitates the inheritance of ethnic music.

Metadata information content of the record and decentralized storage (IPFS): to ensure the standardization of the form of music preservation, but also conducive to the data of efficient indexing and reliable preservation, the latter to achieve the latter mainly rely on the data dispersed storage in multiple nodes.

Technology and hash values on the blockchain: using the blockchain's tamper-proof characteristics to record the ownership and usage records of music copyrights, by calculating and storing hash values in audio files to ensure the integrity of the files in transmission or storage and to be used to trace the originality of the files and the usage of the music.

To sum up, this technology has important innovative value and practical value for the digital preservation and inheritance of national music, and through the popularization and application of this technology, it can

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better protect and inherit the musical cultural achievements of human beings and promote the digital process of human civilization to move forward.

4 Practical analysis

4.1Background

In this regard, I introduce a more mature music streaming platform that combines metadata and blockchain, hoping that it will provide a reference for the technology of digital protection of ethnic music. Audius is a decentralized music streaming platform, which empowers the platform's music artists with more control through blockchain technology and enhances the transparency and fairness of the management of music copyrights. Compared with traditional streaming platforms (e.g., Spotify, Apple Music), it employs distributed architecture and smart contract technology to provide an unmediated and transparent music ecosystem for artists and users. The relevance of introducing Audius to this study is shown in Table 1.

Table 1 Potential advantages of Audius technology application in digital preservation of ethnic music

realm	Audius technology applications	Reasons applicable to digital preservation of ethnic music
Copyright protection and management	Regional chain technology registers music copyrights and ensures that uploads, updates and access to works are traceable on the blockchain.	Dealing with copyright and attribution issues in the digitization process and reducing disputes over copyright of works.
Metadata applications and standardization	Includes titles of repertoire, singers of works, regions, ethnic backgrounds, and historical causes.	Metadata applications can be more effective in conveying cultural information and facilitating resource arc-hiving, scholarship, and education.
Decentralized Storage Solutions	Take advantage of distributed storage technologies such as IPFS to store audio files and metadata.	Improved data security and accessibility to avoid single points of failure.
Transparency and community participation	Decentralized platform structure that enhances user-creator interaction and supports community engagement and feedback.	The community structure and transparent mechanisms encourage more musicians to participate.
Incentives for innovation	The token economy incentivizes creators and listeners, supporting work uploading, voting and interaction.	The uploading and distribution of digital platforms will promote the continued growth and activity of ethnic music.

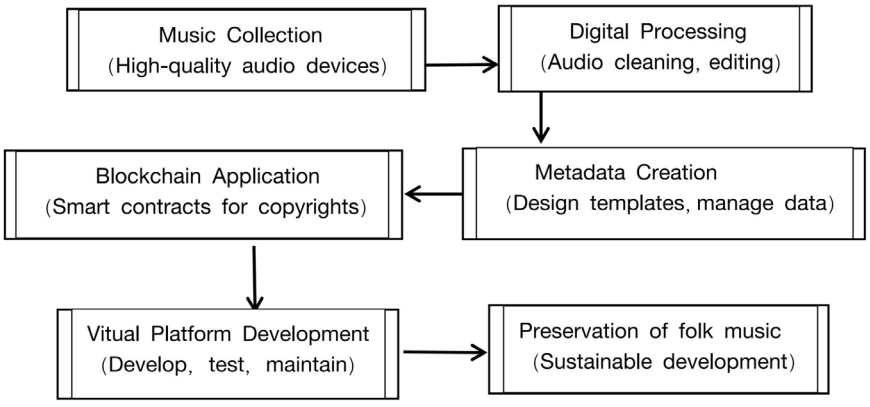


Figure 1 The technical framework was established to realize the designed digital ethnic music module

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5 Discussion

Digital preservation of ethnic music is a response to the changing traditions and the urgent need to pass on ethnic music in response to the development of the times. With the continuous progress of digital technology, the digital preservation of ethnic music has become more and more important, but at the same time, it is also faced with various technical and ethical challenges, Sachdev & Pokhriyal (2020) pointed out that successful digitalization projects cannot be achieved without the support of the state and technicians. Especially in the preservation of traditional ethnic music, the innovation of technological tools becomes crucial in the process. However, it is not only the technological aspect that deserves our attention, but also the far-reaching implications at the ethical and social levels.

The first technical challenge encountered is the quality and format conversion of ethnomusicology. Many ethnic audio materials originate from old tapes, records and other media, which may be damaged or cracked in the process of transferring and recording, and it is also a complex process to repair these materials, as well as to collect these old materials together on a large scale. There is also the phenomenon of the loss of the music of many ethnic groups, which contributes to the lack of ethnic music, not to mention its preservation. Although Adobe Technologies provides appropriate facilities for the post-production and editing processes of audio production and processing, and these facilities can improve audio quality, there are also severe tests for technicians. In addition, the accuracy of real-time audio transcription is a technical challenge that cannot be ignored in the digital preservation process. These tools often face this language interference when dealing with complex ethnic music. Therefore, manual intervention and proofreading are still indispensable parts of the transcription process. Another technical issue is the challenge of long-term data preservation. Although the joint use of metadata and blockchain technology thankfully provides a guarantee for its preservation, the technical requirements are high, and the difficulty factor is high. Through cooperation with traditional and ethnic musicians, the collected scores and recorded audio are uploaded to the blockchain platform along with metadata. Blockchain technology creates corresponding metadata slabs to store the audio and score examples. The management of permissions is in a small number of owners, transferees, and data managers, and the limited tracking and management of these blockchains makes the long-term preservation of traditional ethnic music a reality. This also solves the copyright problem to some extent, Zhi (2017) special cases may also require legal recourse. The drawback is that copyright data on blockchain platforms are usually managed by a small number of owners, assignors and data managers, and how to ensure that the authority of these managers is not abused to ensure fairness and transparency in the process is also a concern. The uploading of music resources on region-chained platforms with greater reward remuneration might also be part of the discussion. It remains to be noted that the limitations of platform resources and the “invisibility” of ethnomusicologists may result in a slower digitization process. Nevertheless, digital preservation of ethnomusicology remains significant in practice.Metadata and blockchain as preservation technologies provide a new solution for preserving ethnic music, ensuring the historical and cultural value of these musical works, and breaking through geographical restrictions and barriers to musical and cultural exchanges, so that valuable ethnic music can have a larger platform to play. Promoting digital preservation also provides rich research resources for academic researchers and educators, thus promoting the development of digital research and dissemination. Most ethnic musicians live in the city, and the normality of their lives may have long since departed from their original artistic environment, and the implementation of a digital platform provides a more comprehensive

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approach to the preservation and dissemination of ethnic music. This approach not only protects the musical, cultural and historical values of traditional ethnic music,but also provides a sustainable security infrastructure across generations.Overall, the preservation and transmission of digitized ethnic music has some challenges, but it still opens new paths for the long-term development of ethnic music.

6 Conclusion

The digitization of scores and audio enriches the information of score resources, facilitates the availability of scores, and lays the foundation for future ethnomusicological research and resource development. Secondly, ethnic music is one of the cultural roots of a nation, and preserving these cultural roots through digitization also enriches the understanding and recognition of their own culture by their own population. The Chinese government attaches great importance to the preservation of excellent traditional culture and highly praises cultural self-confidence. The theoretical aspect of digitization is also in line with the national policy direction, which is conducive to strengthening cultural self-confidence. Digital preservation provides new ideas vitality and vigor for the sustainable development of ethnic music and provides a path for more people who want to listen to the musical origin of their own ethnic group; the digital preservation of ethnic music is enriching the forest of Chinese national culture. In addition to digital technology to protect ethnic music, other digital technology also demonstrates the fresh vitality it gives to music. This study has some limitations in the selection of practice samples, and future research is expected to build on more specific practice studies to add credibility to the feasibility discussion of the article. Future digital preservation is likely to be supported by AI technology, for example, in the combination of AI composition technology and intangible cultural heritage music preservation, the Shanghai Conservatory of Music takes Song Yang & Gao Qiang as an example of music inheritance and art poverty alleviation through AI technology. As the social economy continues to flourish, social culture is booming. Music, as a part of the cultural industry and one of the most popular art forms, is also playing its unique value in the social culture. In the face of the needs of cultural and artistic development in the new era, ethnic music should keep pace with the times and combine with digital technology to realize the sustainable development of ethnic music. This must be in line with the digital platform to achieve digital preservation, metadata management, and blockchain technology pathways. Promoting the preservation of digitized traditional ethnic music requires the strong support of government departments, the efforts of ethnic musicians, digital preservation platforms, and other synergies; it is a long and difficult task, and it also requires us to make concerted efforts to continuously participate in the improvement of the music digitization and jointly create a broader future of music digitization. In the future, digital technology may form a new development industry in traditional ethnic music or art, and traditional ethnic music is also destined to rely on the construction of the digital resource platform to move forward, injecting new vigor and vitality into the prosperity of the national arts and cultural undertakings, increasing the cultural pride of the whole nation, and adding cultural vitality.

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