

# Research on the Construction of Miao Music Database in the Context of Digitization

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## Abstract:

Under the background of rapid development of digitization technology, the protection and inheritance of traditional music of ethnic minorities are facing new opportunities and challenges. As an important intangible cultural heritage in China, Miao music has important protection value for its rich music types and cultural connotations. This paper focuses on the construction of a digital database of Miao music, and carries out research from data collection, digitization processing, database design and implementation and other aspects to explore the application path of digital technology in the protection of Miao music. The study shows that the digital database can not only efficiently preserve and display Miao music, but also promote its cultural dissemination and academic research. The purpose of this paper is to provide technical reference and practical reference for the digital preservation of Miao music.

## Keywords:

Miao Music, Digital Preservation, Database Construction, Cultural Inheritance

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## 1. Introduction

Miao music is one of the important intangible cultural heritages in China, which is famous for its rich genres, complex melodies and deep cultural connotations, including various forms of Lusheng music, Flying Songs, and ritual music. This music is not only a concentrated manifestation of Miao culture, but also an important carrier of the nation's historical memory. However, with the modernization and globalization of society, the living environment of Miao music has changed significantly. On the one hand, the interest of the younger generation has gradually shifted to popular music, and the learning and inheritance of traditional music has gradually declined; on the other hand, the traditional inheritance method is highly dependent on oral transmission and lacks systematic recording and preservation means, resulting in the threat of loss of some forms of music [1].

In this context, the rapid development of digital technology provides new possibilities for the protection and transmission of intangible cultural heritage.

Through digital means, Miao music can be efficiently recorded, stored, analyzed, and disseminated, making up for the shortcomings of traditional conservation methods. For example, high-fidelity recording equipment and video technology can accurately record the sound quality and performance details of the music, while database and Internet technology can realize the long-term preservation and global sharing of music resources. It is under this general trend of digital transformation that the construction of a Hmong music database has become an important way to protect national music culture.

The construction of the Miao music database in the context of digitization not only has academic value, but also has important practical significance. Its academic value lies in the systematic and structured preservation of Hmong music data, providing researchers with convenient access to resources and supporting in-depth interdisciplinary research in areas such as ethnomusicology, digital humanities and computational musicology. At the same time, databases can facilitate cultural exchange and bring Hmong music to greater attention and understanding on a global scale.

On a practical level, digital databases can serve as a core tool for cultural education and dissemination, especially in schools and cultural institutions in ethnic areas. For example, through digital platforms, young Hmong people can have easier access to their own ethnic music, thus enhancing their sense of identity with their own culture. In addition, the database can serve the cultural and creative industries by providing resource support for the innovative application of traditional music in modern art and business. More importantly, the construction of the database can help promote the modernization and transformation of cultural heritage protection and provide a successful example for the digital protection of other minority cultures.

Digital music preservation has become a hot research field in the international arena, and many countries and institutions have carried out relevant practices. For example, the Library of Congress in the United States has developed the Ethnomusicology Archive, which systematically preserves the music of North American aborigines. European countries have used digital platforms to record and disseminate traditional music from different regions, such as the “English Folk Dance and Song Society” database in the UK, which provides convenient search and research functions. In contrast, China is a late starter in the digital preservation of ethnic music, but has made rapid progress in recent years. Some researchers and institutions have begun to pay attention to the digitization of ethnic minority music, such as the “Digitization Project of Chinese Traditional Music” and the construction of the “Miao Music Archive” in Guizhou Province [2]. However, most of the current domestic research focuses on resource collection and lacks systematic database construction and interdisciplinary application exploration. By synthesizing domestic and international research and practical experience, this study proposes a set of solutions for the digital preservation of Miao music, with the aim of providing theoretical guidance and technical support for related fields.

## **2. Data Acquisition and Digitization Processing**

The key to constructing a database of Hmong music lies in high-quality data acquisition and scientific digitization processing. This part elaborates the data acquisition path, collection content, and the technical process and standards of

digitization processing to ensure the completeness, scientificity and usability of the data.

## ***2.1. Data Acquisition***

### ***2.1.1. Collection Objects and Scope***

Miao music has a rich variety of types and styles, covering a wide range of forms such as folk songs (e.g., flying songs, love songs, ancient songs, etc.), instrumental music (e.g., lusheng, mouth strings, etc.), song and dance music, and so on. This data collection will cover all types of musical works from the main areas inhabited by the Miao people, including but not limited to traditional classical repertoire, recordings of live performances by folk artists, and ceremonial music related to Miao music. Meanwhile, Miao music from different regions and clans will also be categorized and collected to ensure the comprehensiveness and representativeness of the database content.

### ***2.1.2. Collection Methods and Tools***

#### ***2.1.2.1. Field Survey Collection***

Field Recording: A professional music collection team is organized to go deep into the villages where the Miao people live and use high-fidelity recording equipment (such as professional-grade tape recorders, directional microphones, etc.) to make field recordings of live performances by folk artists and music played in traditional ceremonies. During the collection process, emphasis is placed on recording the environment, scene and relevant cultural background information of the musical performances to ensure that the collected audio data has high cultural value and research significance.

Video Recording: In addition to audio collection, high-definition camera equipment is also equipped to record the video of the music performance. The content of the video not only includes the music performance itself, but also covers the performer's movements, expressions and interactions with the audience, etc., which provides intuitive visual information for the subsequent research on the performing art form of the Miao music ethnic group.

#### ***2.1.2.2. Literature Collection***

Library and Archives Research: go to libraries and archives in different places to check books, periodicals, manuscripts, records and other historical literature related to Hmong music. Organize and copy the music scores, text descriptions, audio materials, etc. in them, and incorporate them into the literature resources section of the database.

Network resource mining: search and collect publicly available digital resources of Hmong music using platforms such as Internet search engines, academic databases, and ethnomusicology-related websites. Filter and screen these network resources to ensure that they are of reliable origin and high quality, and use them as supplementary data sources for the database after obtaining authorization.

#### ***2.1.2.3. Expert Interviews and Oral History Collection***

Expert Interviews: experts in ethnomusicology, scholars of Miao cultural research, and senior folk artists are invited to conduct interviews. Through the interviews, we

learn about the historical origin, cultural connotation, inheritance lineage, and differences in musical styles in different regions of the Miao music. The interviews are preserved in the form of written records and audio recordings, and organized into oral history materials, providing rich background knowledge and interpretive information for the database.

**Oral history collection:** Go deep into the Hmong community and communicate with local residents, especially those elderly people who have deep memories and experiences of passing on traditional music. Through oral history collection, record their memories of Miao music, learning experiences and family inheritance stories, etc. These oral materials can add vivid humanistic and emotional colors to the database.

### ***2.1.3. Collection Quality Control***

#### ***2.1.3.1. Audio quality standards***

During the field recording process, the noise level of the recording environment is strictly controlled, and relatively quiet venues are selected for recording to avoid external interference. Adopt professional audio processing software to carry out preliminary processing of the collected audio data, remove possible noises, echoes and other interference signals, and ensure the clarity and purity of the audio.

For the collected audio files, they are stored and labeled according to the unified format standard. The audio format adopts lossless compression format (e.g., WAV, FLAC, etc.) to retain the original quality of the audio. At the same time, detailed records of collection time, location, performer's name, music type and other information are recorded in the metadata of the audio files to facilitate subsequent retrieval and management.

#### ***2.1.3.2. Video Quality Standards***

During the video recording process, ensure the stability of the camera equipment and the clarity of the picture. Use tripods and other auxiliary equipment to fix the camera to avoid picture shaking. Post-edit and optimize the video screen, remove irrelevant shots, and adjust the color and brightness of the screen to achieve a high visual quality.

The format of the video file adopts the common high-definition video format (e.g. MP4, AVI, etc.), and is stored according to the unified naming rules. Information such as recording time, location, performance content, etc. are indicated in the metadata of the video files, so as to facilitate users to quickly find and browse related video resources in the database.

#### ***2.1.3.3. Quality standards of literature***

For literature collected from libraries, archives and other institutions, carefully check the version information, author information, publication time, etc. of the literature to ensure its authenticity and accuracy. For reproduced literature, check its clarity and completeness, and if there are missing pages, blurring, etc., make timely supplement and repair.

For online resources, strictly examine the authority and credibility of their source websites, and prioritize materials obtained from academic-accredited databases, official websites and other channels. The copyright audit of network resources is conducted to ensure that the collected information meets the requirements of

copyright laws and regulations, and the source of information and copyright information are indicated in the database.

## ***2.2. Digitization Processing***

### ***2.2.1. Audio Digitization Processing***

#### ***2.2.1.1. Format Conversion and Standardization***

Uniformly convert the various audio formats captured (such as analog tape recordings, digital audio files with different encodings, etc.) into standard lossless audio formats (such as WAV). Format conversion through audio processing software, to ensure that the conversion process does not lose the quality of audio and detailed information.

Standardize audio files, including unifying parameters such as sampling rate (e.g., 44.1kHz) and quantization bit (e.g., 16-bit), so as to make them meet the requirements for database storage and playback. At the same time, the audio files are normalized, and the peak volume of the audio is uniformly adjusted to a suitable range, so as to avoid the volume being too large or too small to affect the user's listening experience.

#### ***2.2.1.2. Audio Analysis and Feature Extraction***

The audio analysis tool is used to analyze the audio file in depth and extract the feature information of the audio, such as melody lines, rhythmic patterns, timbre features, harmonic structures, etc. These feature information will serve as important attributes of the audio data and provide a basis for subsequent music classification, retrieval and research.

For example, the Mel Frequency Cepstrum Coefficient (MFCC) of audio can be extracted by audio analysis software, which is a parameter that can reflect the timbre and melodic characteristics of audio. By analyzing the MFCC of a large number of Hmong music audios, it is possible to classify and cluster analyze Hmong music from different regions and styles, and to discover their intrinsic similarities and differences.

#### ***2.2.1.3. Audio Restoration and Enhancement***

For some age-old audio materials with poor preservation conditions, such as audio ripped from old records and early tapes, audio restoration technology is used to restore them. Remove the noise, hiss, cassette sound and other interference signals in the audio to restore the original sound quality of the audio.

At the same time, appropriate enhancement processing of the audio, such as adjusting the frequency of the audio through the equalizer, responding to highlight the main part of the music, enhance the three-dimensionality and layering of the audio, so that it is more suitable for playback on modern audio equipment.

### ***2.2.2. Video Digitization Processing***

#### ***2.2.2.1. Video Format Conversion and Compression***

Converts captured video files in different formats (e.g., AVI, MOV, MPG, etc.) into a unified high-definition video format (e.g., MP4). In the process of format conversion, efficient video coding technology (e.g., H.264) is used for compression to

reduce the storage space of the video files, while retaining the original quality of the video as much as possible.

The resolution of video files is standardized and uniformly adjusted to common high-definition resolution (e.g., 1080p). For low-resolution videos, the resolution is upgraded by video interpolation algorithms to reach high-definition standards and improve the visual effect of the video.

#### ***2.2.2.2. Video Editing and Labeling***

The captured video footage is edited using video editing software to remove redundant footage unrelated to the theme and extract the core content closely related to the Hmong music performance. For example, non-core shots such as the preparatory process of the performers and the audience's reaction in the video are cropped to highlight the music performance itself.

The content of the video is labeled in detail, including the title of the video, the name of the performer, the location of the performance, the time of the performance, the type of music, the form of the performance, and other information. At the same time, key scenes and important actions in the video are labeled with timestamps, so that users can quickly locate the parts of interest when watching the video.

#### ***2.2.2.3. Video Special Effects and Optimization***

Without affecting the authenticity of the video, the video is processed with appropriate special effects, such as adding subtitles and transition effects. Subtitles can provide a brief introduction to the musical works in the video, including the general meaning of the lyrics, the characteristics of the music style, etc., to help users better understand the content of the video.

Optimize the screen color of the video, adjust color temperature, contrast, saturation and other parameters to make its color more natural and vivid. At the same time, balance the brightness of the video to avoid the screen too dark or too bright, and improve the overall visual quality of the video.

#### ***2.2.3. Digitization of Documentation***

##### ***2.2.3.1. Text Digitization Entry***

For paper-based documentary materials, scan them with a high-precision scanner and convert them into electronic document formats (PDF, JPEG, etc.). During the scanning process, ensure that the scanning resolution is high enough (above 300 dpi) to preserve the original typography and text details of the documents.

For scanned image documents, optical character recognition (OCR) technology was utilized to convert them into editable text formats (e.g. TXT, Word, etc.). The OCR recognition results are manually proofread and corrected to ensure the accuracy and completeness of the text content.

##### ***2.2.3.2. Literature Classification and Cataloging***

Classify and organize the literature according to the dimensions of the type of literature (academic papers, monographs, music scores, manuscripts, etc.), subject matter (history of Hmong music, study of musical styles, musical instrument production, etc.), authors, and publication time.

Detailed catalog information is compiled for each piece of literature, including the title of the literature, author, abstract, keywords, publication information, and so on. At the same time, establish a literature indexing system to facilitate users to quickly retrieve the required literature through keywords, authors, topics and other ways.

### 2.2.3.3. Literature Format Conversion and Storage

Convert the literature into a format suitable for database storage and online browsing. For literature in text format, HTML or XML format is used for storage, which is convenient for displaying on web pages and text search. For documents in PDF format, optimize the processing, remove redundant blank pages, compress the image size, etc. to reduce the file storage space.

Backup storage of literature data, using multi-copy storage strategy to ensure the security and reliability of literature data. At the same time, an update mechanism for the literature data is established to regularly update and supplement the literature in the database to reflect the latest achievements in the field of Hmong music research.

Through the above data collection and digitization processing methods, the rich resources of Miao music can be transformed into high-quality digital data, providing a solid foundation for the construction, management and application of the subsequent database. In the process of data collection and processing, the quality and completeness of data are emphasized, while relevant laws and regulations and ethical principles are followed to ensure the scientific, authoritative and sustainable nature of the Miao music database.

## 3. Database Design and Implementation

The design and implementation of the Hmong music database is the core part of the whole study, which aims to build a scientific, efficient and user-friendly platform for storing, retrieving and displaying multi-dimensional data of Hmong music. This part describes in detail the architectural design, technical implementation and functional modules of the database, and illustrates its application effect with practical cases.

### 3.1. Database Architecture Design

The database adopts a hybrid architecture combining a relational database management system (RDBMS) and file storage to accommodate the diversity of audio, video and text data. The design follows the Dublin Core metadata standard and is customized with the characteristics of Hmong music, which mainly contains the following core Table 1, Table 2, Table 3:

**Table 1.** Audio table: stores the path of the audio file and related metadata, such as the recording time, performer information, and music type.

| Sound frequency ID | File path       | Entertainer | Music type                      | Length of time | Recording date |
|--------------------|-----------------|-------------|---------------------------------|----------------|----------------|
| A001               | /audio/A001.wav | Li Wen      | reed-pipe<br>wind<br>instrument | 3:45           | 2023-07-12     |

**Table 2.** Metadata Tables: Provide multi-dimensional meta-information to support complex retrieval and data analysis.

| Date ID | Data type          | Area    | functionality | Pitch range | Rhythmic Characteristics |
|---------|--------------------|---------|---------------|-------------|--------------------------|
| D001    | sound<br>frequency | Guizhou | festival      | C4-E5       | Medium Tempo             |

**Table 3.** *User Table: Records the visitor's permission information and operation records to support personalized functions and data security management.*

| User ID | User name | Permission level | Last accessed |
|---------|-----------|------------------|---------------|
| U001    | user01    | General user     | 2024-01-01    |

### **3.2. Technical realization**

#### **3.2.1. Back-end Technology**

The database back-end uses MySQL database system and implements data management interface through Python Django framework. The following design is used: SQLAlchemy is used to manage database connections and improve access efficiency in high concurrency scenarios. Large files (audio, video) are stored in AWS S3 or AliCloud OSS and associated with the database via file paths. Develop RESTful API to support data addition, deletion, modification and complex query functions.

#### **3.2.2. Front-end display**

The front-end is designed using HTML5, CSS3 and React framework to provide user-friendly interface, such as displaying the core information of music resources in the form of cards or tables, and supporting audio and video preview. Support multi-conditional search based on keywords, regions, functions and other dimensions. Demonstrate music features through audio waveforms, score dynamic generation tools (e.g. MusicXML).

#### **3.2.3. Functional Modules**

##### **3.2.3.1. Resource Management Module**

Provide uploading, editing and deleting functions of music resources. For example, if a researcher records an audio of a solo Flying Song and fills in the metadata information (e.g., performer, pitch range) when uploading, the system automatically generates a unique data ID and stores the file path.

##### **3.2.3.2. Retrieval and Analysis Module**

It supports searching by music type (e.g. love song, Lusheng music), function (ritual, wedding) or region (Qiandongnan, Xiangxi). For example, if the user inputs "sacrificial music", the system returns relevant records, including the audio of Lusheng music in a certain place in Guizhou, showing its pitch range (C3-D5) and functional description.

##### **3.2.3.3. Data download and sharing module**

It supports high-privileged users to download audio and video files and generate standardized data reports. For example, the research team downloads all the audio data of love songs in a certain region for the secondary research of sentiment analysis.

##### **3.2.3.4. User management module**

Support multi-level permission management (ordinary users, researchers, administrators), record user operation logs. If an administrator finds that a certain audio data has been deleted by mistake, he or she can quickly locate the problem and recover it through the log records.

### **3.3. Data Security and Maintenance**

In order to ensure the long-term availability and security of the data, the database adopts the following measures: daily incremental backups and weekly full backups are realized and stored in an off-site server. Authenticate user access through OAuth protocol to prevent unauthorized access. Quarterly checking of data integrity, cleaning of redundant data, and updating of metadata information.

## **4. Database Application and Effectiveness**

The Miao music database is not only a digital storage platform for traditional music, but also an open and innovative research and application tool. In order to further enhance the value of the database, it is necessary to explore diverse scenarios of function expansion and practical application in combination with the needs of multiple fields. In this section, we will discuss the direction of function expansion in detail, and look forward to the application prospect of the database by combining with practical cases and research.

### **4.1. Function Expansion Direction**

**Music Analysis Function.** By integrating advanced music analysis algorithms, it supports quantitative research on the characteristics of Hmong music, such as melody, rhythm, and pitch distribution. Spectral analysis using open source tools such as LibROSA, combined with machine learning models to identify melodic patterns and rhythmic features. The researcher used a database to analyze the Lusheng music in Guizhou region and found that its rhythmic structure has obvious periodic characteristics, which can be matched with the time rhythm of the wedding ceremony [5].

**Artificial intelligence-assisted labeling.** Deep learning technology is utilized to improve the efficiency of automatic annotation of music data. Functional recognition of audio data (e.g., distinguishing ritual music from entertainment music) by training convolutional neural network (CNN). Example: In the love song data from western Hunan, the system automatically labeled the lyrics as “love” or “nostalgia” to help researchers efficiently filter related resources.

**Virtual Reality (VR) experience.** Combine the music with VR technology to reproduce the traditional scenes and cultural atmosphere of Miao music. Utilizing the Unity 3D platform, the collected audio and video data are embedded in the virtual environment, and users can experience the Miao wedding or sacrificial ceremony in an immersive way. Visitors experience the Lusheng festival of a village in Guizhou in the museum through VR equipment, where music, dance and scenes are intermingled and reproduced [3].

**Cross-cultural comparison module.** Realize cross-cultural comparative research by introducing other ethnic music data. A multidimensional database is designed to support feature comparison and data sharing of music from different cultures. Users can compare the differences in rhythmic characteristics between Miao Lusheng music and Mongolian Horsehead fiddle music, revealing the commonalities and differences between the two cultures in ceremonial music [4].

### **4.2. Application Prospects**

The database of Miao music provides important resources for academic research in the fields of ethnomusicology, anthropology, and sociology. In *Research on the Polyphonic Structure of Miao Flying Songs* (Chen Jianping, 2022), the researcher retrieved and analyzed more than 50 audio data of Xiangxi Flying Songs through the database, which provided empirical support for their polyphonic characteristics.

As a digitized archive of Miao music, databases play an important role in the preservation and transmission of intangible cultural heritage. Database resources are used in the declaration of ICH to provide detailed audio and video evidence and historical documents. When a village in Guizhou declared a national-level intangible cultural heritage project, it used the database to display the audio of its Lusheng music and the video of sacrificial scenes, which was highly evaluated by the jury. The database provides intuitive and vivid teaching resources for ethnic music education and cultural dissemination. Embedding the audio, score and video of Miao music into music teaching materials and online courses for primary and secondary schools. In the course of “Ethnic Music Appreciation”, a music academy used the database to display videos of lusheng playing and genealogical examples of flying songs, which enhanced students’ interest in learning and their sense of national identity.

The database can promote the deep integration of cultural tourism and cultural creation industry. The database can be used to develop music-themed cultural and creative products for cultural tourism attractions, such as the Miao music box and the virtual musical instrument APP, etc. A tourism company has developed a database based on the database resources. Based on the database resources, a tourism company has developed an online tour called “Hmong Music Journey”, which allows users to listen to the musical stories of each attraction through their cell phones (Li, 2020).

The internationalization of the database can promote the global dissemination of Hmong music and research cooperation. Cooperate with UNESCO to build a global digital resource platform for Hmong music. In the “Asian Traditional Music Comparative Research Program”, the data from the Hmong music database is used as the core material for the comparative study of ritual music in Southeast Asia and East Asia.

In order to further enhance the usefulness and impact of the database, the following improvements are proposed: Continue to collect Hmong ritual music and rare musical genres to improve the comprehensiveness of the database. Develop a more intelligent retrieval system to provide semantic search and recommendation functions. Add a multilingual interface to attract international scholars to participate in research and cooperation.

## 5. Challenges and Future Development

There are still many challenges in the construction of the Hmong music database, such as data storage and long-term preservation still face technical difficulties, especially the compatibility and migration of multimedia data. How to respect the Hmong culture and its intellectual property rights in the digitization process needs to be further regulated.

The construction of the Miao music database can be docked with the national intangible cultural heritage platform to expand the scope of resource sharing. In addition, AI technology can be introduced to realize automatic classification and sentiment analysis of music features. Moreover, a regular collection and update

mechanism can be established to ensure the timeliness and comprehensiveness of the database.

## 6. Conclusions

This paper takes Miao music as the research object and explores the construction method of music database in the context of digitization. Through data collection, digitization processing and database design and implementation, a digitization platform for Miao music with practical application value is constructed. The study shows that the digitization technology can significantly improve the protection efficiency and dissemination effect of ethnic music. In the future, further technical optimization and cultural cooperation will promote the development of this field and provide more support for the inheritance of ethnic culture.

## Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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