

Research on Building an AIGC-Based Database of Minzu Fusion Art Patterns

Jia Pu^{1*}, Dongyan Liu¹

¹ Northwest Minzu University, Lanzhou, China

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Abstract:

This paper focuses on the digital preservation and innovative application of artistic patterns derived from minzu integration, proposing the construction of a database for such patterns based on Artificial Intelligence Generated Content (AIGC) technology. By systematically integrating artistic pattern resources formed through historical interactions among various minzu groups, and leveraging the advantages of AIGC in image recognition, feature extraction, and content generation, this study aims to achieve intelligent management, in-depth exploration, and innovative utilization of pattern resources. The research seeks to address issues of fragmentation and inefficiency in the cultural inheritance, industrial development, and academic research of minzu-integrated artistic patterns, thereby promoting the revitalization and cross-domain application of minzu culture in the digital era.

Keywords:

AIGC, Minzu Integration, Artistic Patterns, Database, Cultural Inheritance, Digitalization

1. Introduction

Chinese culture represents the synthesis of the diverse cultures of all minzu groups. It constitutes the soul of the Chinese nation and serves as the spiritual bond for fostering a strong sense of community for the Chinese nation. In this process, traditional art, as a vital vehicle for cultural transmission, plays a unique role. Through prolonged economic exchange, population migration, and cultural interaction, extensive and diverse artistic patterns and motifs have emerged from minzu integration. These patterns are not only visual expressions of minzu cultures but also significant symbols of the shared consciousness of the Chinese national community. However, such pattern resources are currently scattered across folk artifacts, historical documents, and institutional collections. They lack systematic integration and digital representation, facing challenges such as limited preservation and difficulties in practical application.

In recent years, Artificial Intelligence Generated Content (AIGC) technology has made significant strides in image processing, pattern recognition, and content generation. This progress offers a new technological pathway for the digital preservation and innovative utilization of cultural heritage. This study aims to integrate AIGC technology with research on minzu cultures to construct a comprehensive database of artistic patterns from minzu integration. The database will incorporate functions for pattern collection, feature analysis, cultural annotation, and

intelligent application. Its purpose is to facilitate the systematic preservation of minzu cultures, support interdisciplinary research, and promote industrial development.

2. Research Background and Significance

Throughout its long historical development, the Chinese nation has formed a rich and diverse pattern of multi-minzu cultural integration. Through various forms such as economic exchanges, population migration, and cultural interaction, different minzu groups have created a vast array of artistic patterns and motifs characterized by fusion. These patterns not only carry the historical memory and aesthetic concepts of each minzu but also serve as important visual representations of cultural identity for the Chinese nation. The assertion that Chinese culture is the synthesis of all minzu cultures and constitutes the soul of the Chinese nation underscores the contemporary significance of preserving and transmitting these cultural achievements of minzu integration. However, the protection and transmission of integrated minzu artistic patterns currently face numerous challenges. On one hand, these valuable resources are mostly scattered across material carriers such as folk costumes, handicrafts, and architectural decorations, lacking systematic organization; even patterns housed in museums and cultural institutions have not been digitally integrated. On the other hand, with the acceleration of modernization, many traditional crafts face interrupted transmission, and there is a scarcity of professionals capable of interpreting the cultural connotations of these patterns. This leads to risks where a significant number of historically valuable artistic patterns face difficulties in identification, inaccurate interpretation, or even permanent loss. This fragmented state of preservation not only hinders in-depth academic research but also impacts the innovative development of cultural and creative industries.

The rapid advancement of Artificial Intelligence Generated Content (AIGC) technology offers new possibilities for the digital preservation and innovative application of cultural heritage. In terms of image recognition, AIGC enables high-precision identification and classification of complex pattern styles. Regarding feature extraction, deep learning algorithms can mine visual characteristics of patterns such as color, composition, and design. In content generation, AIGC can produce new pattern styles that retain traditional essence while incorporating innovation, based on existing pattern data. Compared to traditional digital methods, AIGC technology demonstrates significant advantages in processing large-scale, multi-source, and heterogeneous image data. Its automated processing capability greatly enhances the efficiency and coverage of cultural heritage digitization. Most importantly, AIGC technology can complement the knowledge of minzu culture experts. Through a collaborative mechanism of “machine recognition + human verification,” it leverages the technological advantage in handling massive datasets while ensuring the accuracy and depth of cultural interpretation. This dual-driven model of “technology plus humanities” provides a feasible pathway to address the dilemma of minzu artistic patterns being “visible yet unreadable, and failing to be transmitted.”

3. Database Construction Methodology and Technical Pathway

3.1. Data Acquisition and Semantic Annotation

The digitization of integrated minzu artistic patterns faces multiple challenges, including dispersed resources, diverse carriers, and complex cultural contexts. The

primary task is to establish a systematic framework for resource acquisition and semantic annotation.

Resource acquisition adopts a tripartite strategy of “fieldwork- institutional collection-literature review.” Professional teams are organized to conduct in-depth fieldwork in minzu regions, utilizing high-precision equipment to digitally capture active patterns preserved on carriers such as clothing, architecture, and artifacts, while simultaneously recording oral histories from artisans and their contexts of use. Concurrently, institutional collections from museums and archives, along with visual materials from ancient texts, local chronicles, and academic publications, are systematically reviewed to build a multimodal resource library covering physical objects, images, and texts. To manage the vast amount of raw data, AIGC-based preliminary image recognition and classification technology is introduced to automate the initial screening and categorization of massive image sets, thereby enhancing foundational work efficiency and allowing researchers to focus on tasks requiring expert judgment.

The more challenging task is imbuing the patterns with interpretable and retrievable cultural semantics. A hierarchical annotation system is therefore constructed: at the foundational level, visual attributes (e.g., motif, color, composition) and objective information (e.g., associated minzu, collection location, carrier) are annotated; at the interpretive level, deeper cultural connotations are linked. This stage employs a collaborative mechanism of “machine-assisted, expert-led” annotation. AIGC technology can perform style analysis on patterns and correlate them with existing textual databases (e.g., myths, legends, historical records) to provide experts with preliminary inferences regarding cultural semantics. Final review, revision, and depth are provided by minzu culture researchers based on their specialized knowledge, ensuring the accuracy and rigor of each annotation item-including the symbolic meaning, context of use, and the history of minzu interaction reflected by the pattern. This process essentially transforms tacit, experiential cultural knowledge into structured, computable data, laying the groundwork for the database’s intelligent applications.

3.2. Intelligent Pattern Analysis and Feature Mining

Following the structured ingestion of foundational data, AIGC technology can be utilized for in-depth pattern analysis and feature extraction, forming the technical core for the database’s advanced functionalities. By training specialized deep learning models to perform multi-dimensional analysis of patterns, micro-features such as line curvature, color distribution, spatial layout, and texture density can be quantified and encoded into high-dimensional feature vectors. Comparing the feature vectors of patterns from different minzu groups or periods enables the data visualization of the evolutionary trajectory of a particular pattern style or the quantitative assessment of similarity and integration between pattern elements of different minzu. For instance, the system could automatically analyze the regular simplification or elaboration of a specific floral motif during its cross-minzu dissemination and how color schemes adapt to new aesthetic preferences. Such analysis provides new quantitative evidence for research on the history of minzu interaction and exchange.

Furthermore, based on learning from a vast corpus of annotated patterns, an attempt can be made to construct a mapping model from visual features to cultural semantics. This model can identify statistical associations between specific pattern features and

cultural meanings—for example, the link between a particular spiral motif and the symbolism of “life proliferation,” or the commonality of a specific color combination in certain ceremonial objects. This allows the database not only to recognize pattern morphology but also to preliminarily understand the potential cultural emotions and functional orientations they carry, thereby supporting intelligent retrieval and recommendation based on cultural connotation.

3.3. System Architecture and Core Function Implementation

All data resources and analytical capabilities are ultimately integrated and delivered through a database system with clearly defined functions. The underlying system design emphasizes the efficient storage and secure management of diverse data types. Its core functions, oriented toward practical application needs, mainly include two aspects:

First, intelligent retrieval and recommendation. Users can query by attributes such as minzu, theme, or color, or can upload a reference image. The system quickly retrieves visually similar patterns through feature comparison and presents all relevant contextual information, enabling “image-based search.”

Second, controlled creative-assisted generation. Under the premise of ensuring cultural authenticity, the system integrates a pattern generation module. Designers can input instructions regarding style fusion or element combination, and the system, based on the learned pattern rules, generates novel design proposals that meet the requirements, providing inspiration for cultural and creative product development.

The entire construction pathway adheres to the core principle of “technology-empowered, humanities-led.” AIGC technology is responsible for processing the organization of large-scale data and mining patterns, while the interpretation of cultural value, aesthetic judgment, and innovative application remain human-led. This pathway aims to build a digital platform capable of both preserving cultural heritage in the long term and continuously stimulating contemporary innovative vitality.

4. Key Challenges and Response Strategies

Constructing a database for integrated minzu artistic patterns is a systematic project that applies cutting-edge technology to the complex domain of humanities. In practical implementation, it primarily faces three core challenges: how to effectively integrate pattern resources with significant heterogeneity, how to ensure the cultural authenticity of machine-generated outputs, and how to guarantee the long-term security and vitality of the digital heritage. Addressing these issues requires moving beyond purely technical thinking to establish a comprehensive solution that fosters deep collaboration between technology and the humanities, alongside the simultaneous refinement of institutional frameworks and system architecture.

4.1. Resource Heterogeneity and Standard Integration

A defining characteristic of minzu artistic patterns is their pronounced heterogeneity. Patterns from different minzu groups and regions vary significantly in style, technique, and symbolism; even the same theme may be expressed in vastly different forms. These resources are scattered across physical objects, documents, and digital archives, with inconsistent formats, resolutions, and descriptive standards, creating a highly heterogeneous “data swamp.” Without effective standardized integration, subsequent analysis, retrieval, and application will be extremely difficult.

The key to addressing this challenge lies in combining “pre-emptive standardization” with “dynamic governance.”

At the project's outset, a detailed Data Acquisition and Cataloging Specification must be jointly developed by multidisciplinary experts in minzu studies, art history, and information technology. This specification must not only define technical standards for images (e.g., resolution, format) but, more crucially, establish an extensible metadata framework for cultural attributes. It should clearly delineate how to describe a pattern's associated minzu, period, function, symbolic meaning, etc. At the data acquisition stage—whether through fieldwork or document digitization—strict adherence to this specification is mandatory to ensure standardization “at the source.”

For legacy non-standard data, a technology-assisted, human-driven approach can be employed. Utilizing AIGC's image clustering capabilities, vast amounts of disorganized images can be preliminarily categorized by visual similarity. Experts can then perform manual verification, consolidation, and annotation based on the specification, gradually integrating this data into the main database. This process resembles re-stringing scattered pearls: technology provides the tool for rapid sorting, while experts ensure the accuracy of classification and the coherence of cultural logic.

4.2. Cultural Authenticity and Controllable Generation

The greatest risk in using AIGC for pattern analysis and generation is cultural distortion. The machine may learn the form of a pattern but fail to comprehend the underlying taboos, rituals, and spiritual essence, potentially generating visually appealing but culturally misplaced, or even traditionally offensive, “false heritage.” Furthermore, if the generation process is uncontrollable, the results may be too random to meet specific needs in cultural creativity or research.

Therefore, a generation model operating under “cultural conditional constraints” must be constructed, with the core principle being the embedding of humanistic rules within the technical system. First, at the data level, the patterns used to train the model must be accompanied by cultural labels that have undergone rigorous expert review. This allows the algorithm to learn not only “pattern morphology” but also “pattern meaning and context of use.” Second, in the generation phase, the system should offer rich control dimensions. For example, a designer might specify: “Base it on the Zhuang minzu frog motif, incorporate the liveliness of the Miao minzu butterfly pattern, express the theme of life proliferation, and apply it to silk fabric.” A researcher might set parameters to: “Generate variant forms of integrated diamond patterns that might have appeared in the Tibetan-Qiang corridor region during the Song and Yuan periods.” The system translates these cultural semantics and style instructions into model-understandable parameters for targeted generation.

More importantly, a “Cultural Compliance Review” mechanism must be established. Generated results intended for significant application or public dissemination should be submitted for review by a panel comprising the project's expert committee or representatives of the relevant minzu cultures. This ensures the legitimacy and accuracy of their cultural references. This acts as a “steering wheel” and “brake” for technological creativity, ensuring that innovation proceeds along the correct path of cultural heritage transmission.

4.3. Sustained Operation, Maintenance, and Security

Database construction is not a one-time project but a digital infrastructure requiring long-term operation and continuous updating. It faces a dual challenge: first, how to ensure the technical security and stability of vast amounts of precious digital assets; second, how to establish mechanisms for the database to continuously absorb new research outcomes and respond to new needs, avoiding obsolescence upon completion.

Regarding security and stability, a “defense-in-depth” strategy should be adopted. This includes: at the physical layer, employing distributed storage and off-site disaster recovery backups to prevent permanent data loss from single points of failure; at the data layer, implementing encrypted storage for core assets like original high-resolution images and enforcing strict access controls, differentiating roles such as the public, researchers, and administrators; at the application layer, conducting comprehensive stress testing and security penetration testing to guard against cyber attacks, alongside developing detailed data security emergency plans.

For sustainable operation, the key lies in designing an “open yet controlled” ecosystem. The database should establish standardized contributor agreements and data submission channels, encouraging universities, museums, research institutions, and even qualified cultural practitioners to supplement new pattern resources or research findings, provided intellectual property rights are clear. The project team must establish permanent academic and technical groups responsible for reviewing submitted data, regularly releasing updated data versions, and continuously optimizing retrieval algorithms and functionalities based on user feedback. Concurrently, exploring API collaborations with cultural/creative platforms and educational institutions can allow data to flow and create value in compliant applications, which in turn can support the database's maintenance and development. Only through such measures can the database evolve from a static “repository” into a vibrant “engine” for cultural innovation.

5. Innovations and Research Value

This research achieves innovations across multiple dimensions, including methodology, technology integration, and application models. Its value lies not only in the digital preservation of integrated minzu artistic patterns but, more importantly, in constructing a transferable and extensible framework for the digital transformation of cultural heritage. This provides systematic support for academic research, industrial practice, and cultural dissemination in related fields.

At the methodological level, the study moves beyond the traditional digitization paradigm centered on image capture by proposing and implementing a cultural datafication path that “gives equal weight to form and spirit.” Through the establishment of a human-computer collaborative semantic annotation and analysis mechanism, it structurally links the visual features of patterns with their underlying cultural context, historical origins, and symbolic meanings. This process transforms each pattern from merely a visual record into a “cultural semantic unit” containing multi-layered information. This provides computable and traceable cultural material for interdisciplinary research and lays a solid knowledge foundation for subsequent interpretation and creative reuse.

At the technology integration level, the research constructs not a static pattern repository but an “intelligent cultural platform” equipped with analytical, generative, and recommendation capabilities. This platform deeply integrates the image understanding, feature mining, and generation capabilities of Artificial Intelligence

Generated Content (AIGC). It supports functionalities ranging from the visualization of macro-style genealogies to the deconstruction of micro-ornamental elements, and from cultural semantic retrieval to condition-constrained creative generation. This design enables the platform to simultaneously serve academic research and industrial innovation. Researchers can use it to uncover potential patterns in motif evolution, while designers can directly leverage the system's cultural knowledge and generative capabilities to efficiently translate cultural concepts into design proposals. This represents a functional leap for cultural resources from being “preserved” to being “activated.”

At the application model level, the research explores a prototype for a sustainable, collaborative digital cultural ecosystem. By formulating standardized data specifications and open access mechanisms, the platform creates an authoritative and trustworthy digital archive for scattered minzu artistic patterns, effectively overcoming utilization barriers caused by resource dispersion and inconsistent standards. More significantly, positioning itself dually as a “resource hub” and an “innovation engine,” the platform fosters resource circulation and collaborative creation among academic institutions, cultural organizations, the creative industries, and the education sector. This enables traditional cultural elements to continuously circulate, be reinterpreted, and gain value within modern contexts.

In summary, through its methodological innovation, deep technological integration, and exploration of an ecosystem-based operational model, this research provides a practical framework and theoretical reflection with referential significance for the systematic preservation, innovative transformation, and value regeneration of cultural heritage in the digital age.

6. Conclusions

This research, through the establishment of a human-computer collaborative digital framework, has opened a new pathway for the preservation and revitalization of integrated minzu artistic patterns. This practice demonstrates that when the analytical power of intelligent technology is deeply integrated with the interpretative power of humanistic research, cultural heritage can transcend the limitations of static preservation and transform into a traceable, analyzable, and re-creatable cultural resource. It not only provides new methodological perspectives and an empirical foundation for related academic research but also, by constructing a digital hub that connects historical heritage with contemporary innovation, offers a practical technological solution for the creative transformation of traditional culture.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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References

- [1] Yu, G. (n.d.). The construction and governance of Chinese national cultural symbols in AIGC visual content. *Journal of South-Central Minzu University (Humanities and Social Sciences Edition)*, 2025, 1-13. DOI: <https://doi.org/10.19898/j.cnki.42-1704/C.20251127.01>.
- [2] Wu, Q.Y. Innovation and practice in teaching Database Principles and Applications empowered by AIGC. *Caizhi*, 2025, 34, 13-16.
- [3] Li, R.F.; Zhou, Y. Research on the construction of a database for She ethnic costume patterns in Jiangxi. *Liaoning Sichou*, 2025, 4, 92-93+199.
- [4] He, P.W. Cross-border integration of visual communication design and traditional ethnic patterns. In *Proceedings of the 2024 Higher Education Teaching Seminar*, 2024, 1, 140-141. DOI: <https://doi.org/10.26914/c.cnkihy.2024.025808>
- [5] Zhou, L.; Jin, Y.T.; Li, F. et al.(n.d.).Construction of an AIGC paradigm for generating Wuxi “Jiahua” style patterns. *Progress in Textile Science & Technology*, 2025, 1-6. DOI: <https://doi.org/10.19507/j.cnki.1673-0356.20250905.002>.
- [6] Yu, A.J.; Tang, Z.Y.; Zhang, X.M. Research on the digital transformation and upgrading path of intangible cultural heritage Chaoshou embroidery from the perspective of AIGC: A case study of the Chaoshou embroidery pattern database. *Art Education Research*, 2025, 12, 35-37.
- [7] Lu, Q. Research on Zhuang brocade patterns [Master's thesis, Shandong University]. 2017.
- [8] Huang, B.F.; Deng, H.Y.; Lu, H.X. Research on the protection and inheritance of Zhuang brocade from the perspective of forging a strong sense of community for the Chinese nation: A case study of Jingxi Zhuang brocade. *Journal of Guangxi College of Education*, 2025, 40(4), 123-131.
- [9] Jian, S.Y. Discussion on clothing aesthetics in Lingwai Daida from the perspective of innovation and entrepreneurship: The fourth in a series of studies on “academic learning” for undergraduates in the new era context. *Coastal Enterprises and Science & Technology*, 2019, 1,68-72.
- [10] Fan, D.Z.; Chen, F.M. Preliminary exploration on the research, development, and exhibition of Zhuang brocade from the perspective of smart museums. *Gehai*, 2023, 4, 38-48.
- [11] Li, R.B.; Shi, Z.; Kong, Q. et al. A preliminary exploration of the significance of intelligent classification of ethnic cultural symbols in art design: Taking Zhuang brocade decorative patterns as an example. *Tomorrow's Fashion*, 2020, 12, 1-2, 89.
- [12] Zeng, Z.; Wang, J. Research on innovative design of traditional ethnic patterns based on artificial intelligence: Taking Xilankapu as an example. *Art Science and Technology*, 2021, 16.
- [13] Yu, Y.F. Teaching practice of digital transformation in art discipline education assisted by artificial intelligence: Taking the large-unit teaching of ethnic costumes and patterns as an example. In *Proceedings of the Guangdong Education Society 2023 Annual Academic Conference*, 2023, 2.

- [14]Xie, X.; Tang, B. Research on Cultural and Creative Design Based on Modal Theory and AIGC Technology. *Applied Mathematics and Nonlinear Sciences*, 2024, 9(1), DOI: 10.2478/AMNS-2024-2980.
- [15]Dong, H. Research on Temporal Structures and Cultural Memory Mechanisms in Digital Exhibition Design of Intangible Cultural Heritage. *Journal of Social Science and Humanities*, 2025, 7(11), 50-54. DOI: 10.53469/JSSH.2025.7(11).10.



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