From “Recording” to “Generation”: A Review of Research on Digital-Intelligent Technologies Empowering the Living Transmission of Guizhou Miao Embroidery

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ABSTRACT

In the dual context of globalization and urbanization, Guizhou Miao embroidery—a living heritage that embodies the migratory memory of the Miao people and a women-centered knowledge system—faces a deepening crisis of transmission rupture. Although the introduction of digital technologies has substantially expanded capacities for documentation, dissemination, and representation, it has also brought to the fore global ethical issues concerning the ownership of representational rights, the definition of data sovereignty, and mechanisms of community participation. Drawing on representative research published since 2000, this paper systematically reviews five strands of scholarship: the ontology and cultural interpretation of Miao embroidery; fieldwork and identity construction; digital documentation and safeguarding; intelligent generation and design transformation; and communication, consumption, and culture–tourism integration. The review shows that scholarship is undergoing a paradigm shift from “rescue documentation” to “creative generation,” with digital-intelligent technologies evolving from auxiliary safeguarding tools into a paradigmatic force that is reconfiguring the ecology of Miao embroidery transmission. However, the field remains constrained by fragmented subgroup research, the absence of standards for evaluating cultural accuracy, the disjunction between technological and cultural logics, and the marginalization of transmission subjects. Facing the digital-intelligence era, efforts should consolidate the foundation of a cultural gene bank through digital empowerment, build a human–machine collaborative mechanism for safeguarding authenticity under the guidance of the “AI Plus” initiative, and improve the full-chain closed loop of “documentation–research–transformation–feedback” under the concept of systematic safeguarding, so as to promote the sustainable cultural reproduction of Miao embroidery between technological empowerment and community subjectivity.

Keywords: *Digital-intelligent technologies, Guizhou Miao embroidery, Intangible cultural heritage, Living transmission.*

1. INTRODUCTION: STATEMENT OF THE PROBLEM

Intangible cultural heritage subsists in the everyday practices of specific communities, and its vitality lies in living continuity across generations. Under the sustained impact of industrialization, urbanization, and global markets, living heritage embodied in traditional craftsmanship generally faces the crisis of broken transmission chains. The Convention for the Safeguarding of the Intangible Cultural Heritage establishes “community participation” as a fundamental principle of safeguarding work, requiring States Parties to ensure the widest possible participation of the communities, groups, and individuals concerned at every stage of safeguarding (UNESCO, 2003b)[1]. At the same time, technologies such as three-dimensional scanning, digital archiving, extended reality, and generative artificial intelligence have been rapidly introduced into the heritage field (Bekele et al., 2018)[2]. While digital technologies have expanded the capacities for documenting,

interpreting, and disseminating heritage with unprecedented precision, they have also raised new questions of worldwide significance: Who has the right to represent heritage? Where does the cultural authority of digital surrogates reside? How should the boundaries of data collection and openness be drawn? Debates around these questions have come to constitute a core agenda of digital heritage research (Cameron & Kenderdine, 2007)[3]. UNESCO's successive adoption of the Charter on the Preservation of Digital Heritage (UNESCO, 2003a)[4] and the Recommendation on the Ethics of Artificial Intelligence (UNESCO, 2021)[5] further demonstrates that the ethical governance of digital heritage has become a global institutional concern.

The Miao are an ethnic group with a long history of migration and a transnational distribution in the contemporary era: its branches spread across the southwestern provinces of China and the Southeast Asian countries of Vietnam, Laos, Thailand, and Myanmar, and, with the waves of twentieth-century migration, extend to North America, Europe, and Oceania; ethnographic scholarship has likewise long attended to the cultural politics and textile traditions of this group (Diamond, 1988)[6]. In the historical absence of a script of their own, Miao women took needle and thread as writing instruments, encoding into costume patterns the routes of ethnic migration, the deeds of ancestors, and cosmological concepts; Miao embroidery has thus earned the metaphor of "a history book worn on the body." On this basis, Miao embroidery possesses scholarly value that exceeds its local context in at least three dimensions. First, as a material carrier of migratory memory, it offers a precious case for studying how memory, detached from writing, comes to adhere to cloth and the body. Second, as a knowledge system created and transmitted primarily by women, it presents a complete mechanism for the intergenerational transmission of gendered knowledge. Third, as the product of long-term aesthetic blending in a zone where multiple ethnic groups are interlaced, it provides a microscopic entry point for examining cultural borrowing and integration across ethnic groups. These values also mean that the digitization of Miao embroidery is by no means merely a local cultural project, but a constituent part of the global debate over the digitization of living heritage.

In institutional terms, Miao embroidery and Miao costume were inscribed on China's national intangible cultural heritage list in 2006 and 2008 respectively, and their safeguarding has thereby gained stable institutional support; development projects implemented by Guizhou Province in support of women's handicraft cooperatives have promoted the extension of Miao embroidery from a household sideline toward a scaled industry. Over the past decade and more, digital technologies represented by three-dimensional scanning, knowledge graphs, and generative artificial intelligence have accelerated their intervention in the documentation, research, generation, and dissemination of Miao embroidery; against the backdrop of the continuing advance of China's national cultural digitization strategy, both the safeguarding practice and the academic study of Miao embroidery stand at the juncture of a paradigm shift. It should be emphasized that the fundamental criterion of living-heritage safeguarding lies in maintaining the living existence of a cultural practice within its source community; this principle provides the point of origin for evaluating all schemes of technological intervention.

This paper adopts the research review as its basic method. Taking the China National Knowledge Infrastructure (CNKI) as the principal source, supplemented by the Wanfang and VIP databases, and using search terms such as "Miao embroidery", "Miao costume", "digitization", and "intangible cultural heritage", we retrieved a cumulative total of more than 240 publications issued since 2000, of which approximately 147 are devoted specifically to Guizhou Miao embroidery, including 93 master's and doctoral dissertations. On this basis, representative outcomes in the digitization of ethnic costume and the international literature on digital heritage were also incorporated, and the review proceeds around three progressive questions. First, what stage-based characteristics has the scholarship of the past two decades displayed, and what genealogy of knowledge has it formed? Second, in what sense has the deep intervention of digital technology reconfigured the actor networks and research paradigms of Miao embroidery transmission? Third, in the digital-intelligence era, how can related research and practice achieve theoretical deepening and breakthroughs in pathway? Through the cross-examination of scholarly history and frontier dynamics, this paper aims to provide systematic answers to these questions.

2. MAPPING THE KNOWLEDGE LANDSCAPE: TRADITIONAL FOUNDATIONS AND THE DIGITAL-INTELLIGENT TURN IN MIAO EMBROIDERY RESEARCH

2.1 Literature Compilation and Typological Foundations

The modern compilation of Miao costume began in the 1980s. Chinese Miao Costume, compiled by the Cultural Palace of Nationalities (1985)[7], was the first work to classify Miao dress systematically into "five types and twenty-one styles." Yang (1998)[8], in The Culture of Miao Costume, further refined the classification into fourteen types and seventy-seven styles and offered pioneering interpretations of the cultural functions of dress. Wu (2000)[9], in An Illustrated Record of Chinese Miao Costume, assembled images of 173 costumes into a relatively complete visual catalog.

Research along the historical dimension followed. Lan (1997)[10], in Historical and Cultural Geography of Southwest China, provided a framework for the spatial analysis of the dress of southwestern ethnic groups. Li (2022)[11], in A Geographical Study of Miao Costume in Historical Periods, divided the evolution of Miao dress from the pre-Qin era to the Qing dynasty into five phases and identified three geographic differentiations in Qing-dynasty Guizhou—the large-front-panel (dajin) dress zone of central Guizhou, the pullover (guanshouyi) dress zone of southern Guizhou, and the front-opening jacket zone of southeastern Guizhou—revealing how climate, mountainous terrain, migration, and policy shaped the distribution of dress.

In sum, this strand of research has accomplished the documentary groundwork on the basic forms and spatial distribution of Miao embroidery, and its scholarly contribution deserves recognition. Its limitations are nonetheless evident: classification studies largely remain at the level of formal typology; cultural interpretation is confined to descriptive accounts of static features; the objects of study center on modern and contemporary women's dress, with insufficient attention to diachronic change; and, spatially, regional case studies predominate over systematic cross-subgroup comparison. In the digital-intelligence era, such "catalog-style" accumulations of material must be transformed into structured, computable data assets; otherwise their scholarly value will remain stranded at the level of "preservable cultural documents" and will be unable to enter the category of "regenerable digital resources."

2.2 In-depth Decoding of Pattern Symbols

Pattern research has been the most dynamic direction in recent studies of Miao embroidery proper. Particularly emblematic is the concept of the "mother flower" (muhua) proposed by Zhou et al. (2023)[12]: the term refers to an imitative template that carries the typical pattern information of a given ethnic branch and is marked by heritability and identifiability. Defining its cultural attributes along seven dimensions—material, size, motif, color, technique, arrangement, and accumulated preservation—the study points out that the mother flower possesses the dual dimensions of "form" and "core" and is in effect an "information code" of Miao culture. The scholarly value of this concept lies in its introduction of the category of the "template" into transmission research for the first time, making clear that living transmission is not groundless improvisation but takes the form of "variants with traceable lineages" derived from the mother flower. This understanding carries direct methodological implications for digital-intelligent practice: if intelligent generation is to accord with the essence of "transmission," it must take the pattern genes of the various branches carried by the mother flower as its cultural baseline and coordinate of verification.

Equally noteworthy is the study of migration-type patterns by Xu et al. (2025)[13]. That study classifies migration patterns into the three categories of independent, composite, and integral, and decodes the memories of five great migrations behind such patterns as Mimai ("footprints on the broad road," "steeds flying across the waters") and Langwu ("mountains of gold and silver," "the waves of rivers"), pointing out that Miao women "take needle and thread as their brush and costume as their book," making the patterns a living heritage that carries cultural memory and ethnic identity.

In addition, Xu (2024)[14] systematically expounded, from the perspective of aesthetics and cultural value, the symbolic system of plant motifs in traditional costume and their connotation of the "unity of humanity and nature"; studies from semiotic perspectives by Yang (2022)[15], Sun (2018)[16], Wang and Wang (2023)[17], and others (such as the structural classification of the themes, sign conventions, and meanings of the embroidered patterns on Guizhou Miao costume), together with

the introduction of such perspectives as “bodily narrative” and “cultural genes,” have upgraded pattern research from “iconographic description” to “the analysis of cultural grammar.”

On the whole, research on pattern decoding has basically accomplished the task of “meaning interpretation,” but its outcomes are mostly expressed in natural language and have not yet been translated into machine-readable semantic annotation systems and computational rules—this is precisely the crux of why digital-intelligent technologies cannot “connect with” cultural research, and it is the interface for the next stage of interdisciplinary endeavor.

2.3 Fieldwork, Identity, and Community Studies

Field research in anthropology and ethnology has returned Miao embroidery to its lived contexts. Taking Maomaohe Village in Leishan County, Guizhou as her field site, Long (2026)[18] traced the circulation of embroidered gifts through birth, wedding, and funeral rituals, finding that baby carriers and floral hats facilitate the newborn’s transition from “natural life” to “social person,” that the bridal dress performs a family’s social capital, and that burial dress becomes a spiritual medium for the deceased’s passage from “family member” to “ancestor.” The embroidered gift thereby completes a functional conversion from “private object” to “public symbol” to “spiritual medium,” and sustains the village’s network of social relations with women as the pivotal hub.

The value of such research on “the social life of things” lies in its demonstration that Miao embroidery is not “static and specimen-like” but “living”—and “living” refers not only to the vitality of technique but, more importantly, to its vitality as a medium of social relations. Any digital-intelligent scheme that abstracts embroidery from its ritual contexts and its networks of human feeling preserves only the husk of the patterns, not the life of Miao embroidery.

At a more macro level, Long and Li (2022)[19], taking the costume culture of southeastern Guizhou as an example, demonstrated the practical significance of mutual borrowing and integration among the costumes of multiple ethnic groups for forging a strong sense of community for the Chinese nation. Drawing on Latour’s actor-network theory to analyze the popularity of Hanfu culture, Jiang (2022)[20] revealed an identity-generating mechanism in which “things, people, and media” are interwoven: through the medium of the internet, Hanfu expanded from a niche subculture into an expression of identity laden with patriotic sentiment—an analytical framework with direct methodological relevance for understanding the dissemination and identity construction of Miao embroidery in digital media.

In summary, fieldwork and identity theory have established for Miao embroidery research a value coordinate that moves from “craft” to “culture” and extends from “ethnic marker” to “community bond”. However, an evident paradigmatic gap still exists between current identity research and the application of digital technology: the former rarely examines in depth the mechanisms by which technological factors affect cultural identity, while the latter generally lacks theoretical attention to the process of identity construction. Therefore, promoting the cross-fertilization of the two in methodology and problem consciousness, and achieving interdisciplinary dialogue and integration, should become an important theoretical growth point urgently awaiting breakthrough in Miao embroidery research during the Fifteenth Five-Year Plan period.

3. RESEARCH ON DIGITAL-INTELLIGENT EMPOWERMENT: FROM RESCUE DOCUMENTATION TO CREATIVE GENERATION

3.1 Digital Collection, Archiving, and Memory Construction

On the documentation and preservation side, Geng et al. (2025)[21], taking ethnic costume as their object, integrated full-information three-dimensional scanning and storage, AI-based intelligent restoration, automatic CNN-ResNet classification (achieving an average accuracy of 0.925 across the costumes of five ethnic groups), one-to-one virtual replication, and digital-human display in Unreal Engine, thereby building a complete technical chain of “collection–restoration–recognition–display”; their user-experience evaluation showed that viewers’ sense of cultural identity reached 92.1 percent and satisfaction reached 94.3 percent. From a digital-humanities perspective, Liu et al. (2025)[22] proposed a scheme for constructing the “digital memory” of costume archives: drawing on Pierre Nora’s theory of lieux de mémoire, they built a

three-dimensional framework comprising material, symbolic, and functional dimensions, designed an archival classification of costume, relational, and value dimensions together with a three-level description system, and advocated a GLAM (galleries, libraries, archives, and museums) virtual alliance to promote coordination among multiple actors.

The historical contribution of this strand lies in having basically solved the problem of "storing heritage and transmitting it outward", and its methodological self-awareness—standardized description, digital twins, and multi-actor coordination—deserves affirmation. To be fair, however, most of its outcomes remain preservation-oriented research that "values storage over use": databases are isolated from one another, collection standards are inconsistent, and cultural-semantic annotation is weak. The data are "stored but not alive", and there remains some distance from the standardization and shareability required by such industry standards as Collection and Description of Digital Resources of Intangible Cultural Heritage (WH/T 99–2023).

3.2 Intelligent Generation and Design Transformation

Research on the generative side marks the deepening of the paradigm shift. Wang (2026)[23] used LoRA low-rank fine-tuning to train a generative model of Guizhou Miao costume patterns, introduced a multimodal large model to complete automatic pattern annotation, constructed a five-level prompt system encompassing trigger words, core descriptions, visual features, cultural semantics, and quality modifiers, and embedded constraints on cultural-feature preservation, structural consistency, and color distribution into the loss function; her empirical results show that the cultural-feasibility index of the model-generated patterns reached 4.04, on the basis of which she argues that Miao embroidery creation is shifting from a "handicraft paradigm" toward a "human–machine collaborative paradigm". From a digital-twin perspective, Fu et al. (2025)[24] established a pathway for the design transformation of Miao costume elements: selecting 114 images from 209 costume photographs to build a digital-twin resource library, extracting nineteen characteristic colors by K-means clustering, and then deriving new patterns through shape grammar and mapping them onto cultural-creative products, thereby forming a closed design loop of "extraction–derivation–transformation."

Theoretical reflection on AIGC has kept pace. Drawing on meme theory, Ouyang and Liu (2026)[25] and Li and Liang (2023)[26] distinguish the explicit genes of traditional costume (form, pattern, color, material, and accessories) from its implicit genes (the spirit of the age, cultural connotations, and philosophical thought), pointing out that the integrated application of ViT, three-dimensional Gaussian splatting, and multimodal technologies is forming a trinitarian pathway of "theory–technology–application" for the reconstruction of digital life.

The breakthrough of this research strand lies in the fact that Miao embroidery has been transformed for the first time from an "inscribed cultural object" into a "generable cultural resource," with the effect of technological empowerment becoming increasingly salient. Its limitations, however, should not be overlooked. On the one hand, the "cultural authenticity" of generated patterns still lacks systematic evaluation indicators and verification mechanisms: although the patterns output by artificial-intelligence models visually approximate Miao tradition, they do not necessarily carry its deeper cultural signifieds. On the other hand, existing subgroup research concentrates on hotspot areas such as Shidong, Taijiang, Leishan, and Danzhai, and the pattern genes of a large number of branches have yet to be incorporated into training datasets. Overall, technological iteration has outpaced the construction of cultural conventions; in the absence of an effective cultural calibration mechanism, AIGC, while expanding the reach of Miao embroidery, may also aggravate the misreading of pattern meanings and the homogenization of style.

3.3 Communication, Consumption, and Industry Integration

Research on communication and consumption responds to the question of "how digital-intelligent outcomes enter everyday life." Based on a survey of consumption willingness, Zhang (2024)[27] found a significant rise in younger groups' acceptance of the digitization of intangible-cultural-heritage costume, and advocated activating the consumption end through the integration of virtual try-on, AR experiences, and modern design. Taking the China (Shenzhen) International Brand Clothing and Accessories Fair as an example, Jia (2023)[28] proposed communication strategies of building a

costume-culture database, creating an online education platform, and developing digital IPs of ethnic costume.

Examining Zhuang costume, Huang and Zhang (2025)[29] identified practical dilemmas in digital safeguarding and development: technological application remains at the shallow level of image-text display and short videos; pattern elements are copied directly without semantic translation; awareness of cultural IP is weak; and there is a gap in interdisciplinary transmission talent. They accordingly emphasize "technology for good" as a framework and warn against technology's erosion of cultural nature. Situated in the context of the deep integration of culture and tourism during the Fifteenth Five-Year Plan period, Zhan (2026) proposed a five-in-one paradigm of "authenticity safeguarding–living transmission–creative transformation and innovative development–value feedback," advocating the construction of a digital gene bank and the establishment of institutionalized channels for returning benefits to source communities.

Overall, this research strand has preliminarily formed a systematic research chain of "safeguarding–interpretation–transmission–innovation"; its positive significance lies in its self-conscious reflection on homogenized and superficial consumption tendencies and in its sustained emphasis on the construction of cultural-feedback mechanisms. However, current research remains dominated by policy recommendations, with relatively weak empirical support; key institutional designs concerning feedback pathways, quantitative standards, and supervisory subjects are still at the advocacy stage, lacking operable implementation schemes and effect-verification mechanisms.

4. OVERALL ASSESSMENT: THE EVOLUTIONARY LOGIC OF SCHOLARSHIP AND PROMINENT PROBLEMS

4.1 Evolutionary Logic: Three Stages of Progression and a Paradigm Shift

In terms of scholarly history, research on Guizhou Miao embroidery and the digitization of ethnic costume since 2000 has evolved through three stages: a period of sporadic beginnings before 2014, a period of accelerated growth from 2014 to 2018, and a period of high-level fluctuation thereafter; cumulative publications have reached more than 240, including some 147 studies devoted specifically to Guizhou Miao embroidery and 93 master's and doctoral dissertations.

More important than quantitative growth is a triple ascension in the internal logic of research. First, the research object has deepened from "things" to "cultural genes"—from the recording of costume forms and patterns to the decoding of the transmission codes of mother flowers, motifs, and migratory memory. Second, the research method has been upgraded from "recording" to "generation"—from photographic archiving and three-dimensional modeling to knowledge graphs, digital twins, and AIGC-enabled creative generation. Third, the research goal has expanded from "safeguarding" to "development"—from rescue-oriented preservation to systematic development that empowers industry, feeds back into communities, and constructs identity.

From this the following basic judgment can be formed: digital-intelligent technologies are no longer merely "tools" that assist the safeguarding of Miao embroidery, but are progressively reconfiguring the very ecology of Miao embroidery transmission, and thus carry theoretical significance at the "paradigm" level—they have changed the ways in which Miao embroidery is recorded, the paths by which it is interpreted, the mechanisms by which it is produced, and the forms in which it is consumed. On this basis, the evaluation of digital-intelligent empowerment effects should not be confined to considerations of technical efficacy, but must return to "living transmission," the fundamental principle of intangible cultural heritage safeguarding, for scrutiny and verification.

4.2 Prominent Problems: Four Structural Shortcomings

Measured against the yardstick of living transmission, existing research exhibits four structural shortcomings.

The first is subgroup fragmentation coexists with data barriers. The Miao comprise numerous branches with diverse patterns, yet existing research and database construction concentrate on a few hotspot branches; cross-regional and cross-branch comparative research and shared corpora are absent, and the resulting "data islands" make it difficult for digital-intelligent empowerment to cover the full diversity of Miao embroidery culture.

The second is standards for evaluating cultural accuracy are absent. Research on intelligent generation generally attaches more weight to "generation quality" than to "cultural validity," and lacks an evaluation-index system benchmarked against mother-flower templates, pattern semantics, and branch norms, so that the risk of cultural distortion lacks scholarly gatekeeping.

The third is technology and culture remain "two separate skins," and transmission subjects are marginalized. Technology researchers are not well versed in the cultural logic of Miao embroidery, while cultural researchers do not command digital-intelligent tools; in digital narratives, embroiderers and heritage-bearer groups are mostly presented as "material providers" rather than "knowledge subjects," and their craft experience, aesthetic judgment, and rights to benefit have not been institutionally incorporated into digital-intelligent workflows.

The fourth is property-rights and feedback mechanisms run idle. Institutional regulation is lacking for the collection, rights confirmation, licensing, and revenue distribution of pattern data, and channels for returning digital outcomes to source communities have yet to be established. In short, current research supplies "technology" faster than "cultural norms" and builds "platforms" faster than it "activates subjects." These are the real problems that must be faced squarely during the Fifteenth Five-Year Plan period.

5. DIGITAL-INTELLIGENT EMPOWERMENT: PATHWAYS FOR THE LIVING TRANSMISSION OF GUIZHOU MIAO EMBROIDERY

5.1 Guided by "Digital-Intelligent Empowerment and Informatization Transformation", Consolidating the Foundation of a Miao Embroidery Cultural Gene Bank

Digital-intelligent empowerment presupposes a high-quality, standardized, and shareable data foundation. We recommend taking such industry standards as Collection and Description of Digital Resources of Intangible Cultural Heritage (WH/T 99–2023) as the norm, relying on the national cultural digitization strategy and the construction of a nationally integrated data market, systematically conducting multimodal collection of the patterns, techniques, and oral histories of all branches of Guizhou Miao embroidery, and building a "Miao embroidery cultural gene bank" covering every branch. Particularly worth emphasizing is that the "mother flower" should serve as the cultural benchmark dataset: mother flowers carry the typical pattern information and transmission norms of their branches, and their digitization and standardization can both correct the cultural bias of generative models and provide fragmented branch studies with a unified coordinate of comparison. On this basis, the construction of a semantic-annotation system and a knowledge graph for Miao embroidery should be advanced, so that past interpretive outcomes are translated into machine-readable computational rules, opening up the "interface" between cultural research and technical research.

5.2 Led by the "AI Plus" Initiative, Building a Human–Machine Collaborative Mechanism for Safeguarding Authenticity

The deep intervention of generative artificial intelligence has turned the question of authenticity from a theoretical issue into an urgent practical one. Cultural authenticity is not frozen and immutable, but a dynamic unity of three structures—the material, the ritual (scenic), and the spiritual; the essence of living transmission lies precisely in safeguarding the spiritual core while allowing the contemporary evolution of form.[30]

Accordingly, "AI + Miao embroidery" should not seek to replace embroiderers with machines, but should be positioned as human–machine collaboration: AI undertakes the collection, classification, derivation, and assisted design of patterns, while heritage bearers retain the power of cultural review and final creation. At the academic level, we recommend establishing evaluation standards for the cultural accuracy of intelligently generated Miao embroidery and forming a verification mechanism jointly involving ethnologists, heritage bearers, and technical experts; at the application level, we recommend generalizing a generative workflow of "mother-flower baseline + shape-grammar constraints + human verification," so that generated patterns not only "look like" Miao embroidery but also "are" Miao embroidery. Only in this way can "creative transformation and innovative development" avoid sliding into "alienated production" in the sense of cultural distortion.

5.3 Taking Systematic Safeguarding as Method, Improving the Full Chain of "Documentation–Research–Transformation–Feedback"

Intangible cultural heritage calls for systematic safeguarding. For Miao embroidery, "systematic" means connecting the complete chain from documentation to feedback: at the front end, multimodal collection and standardized description ensure that heritage is "comprehensively stored"; in the middle, knowledge graphs and intelligent research tools ensure that it is "deeply studied"; at the back end, design transformation, immersive display, and educational curricula ensure that it is "well used"; and at the far end, institutionalized revenue distribution ensures that benefits are "duly returned"—so that source communities and heritage-bearer groups fairly share the proceeds of digital-intelligent development.

Concretely, explorations may be made into systems for the intellectual-property registration and licensed use of Miao embroidery pattern data, clarifying bearers' digital rights and interests in their skills and works; digital-literacy training for embroiderers should be promoted, transforming them from "the recorded" into co-builders of digital resources and operators of digital platforms; and, drawing on the benefit-feedback ratio schemes proposed in relevant research, a certain proportion of revenues from digital collectibles, cultural-creative licensing, and the like should be institutionally returned to village transmission undertakings.

Living transmission is ultimately the transmission of "people." Only when digital-intelligent technologies are converted into productive tools in the hands of embroiderers, tangible income in village accounts, and cultural pride among the younger generation can they be said truly to serve the word "living."

6. CONCLUSION

From mother-flower templates worked stitch by stitch to intelligent generation computed algorithm by algorithm, Miao embroidery stands at the intersection of tradition and the future. More than two decades of scholarly accumulation show that Miao embroidery research has moved from typological compilation to cultural decoding, from rescue documentation to creative generation, and from a single discipline to cross-border integration; the intervention of digital-intelligent technologies is not a replacement for or a dissolution of living transmission, but provides it with unprecedented precision of documentation, depth of interpretation, and breadth of dissemination. Facing the Fifteenth Five-Year Plan period, the touchstone for measuring every digital-intelligent empowerment scheme remains living transmission itself: technology should be bounded by the safeguarding of cultural authenticity, empowerment should take the activation of transmission subjects as its essential aim, and development should take the forging of a strong sense of community for the Chinese nation as its destination. Following this path, Guizhou Miao embroidery—this "history book worn on the body"—will surely continue to write new chapters in the digital-intelligence era, contributing distinctive ethnic wisdom to the building of China into a country strong in culture.

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