

Research on the Design of Cultural Homestay Spaces of Langde Miao Village's Miao Embroidery Empowered by Digital Intelligence

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ABSTRACT

This study aims to align with and satisfy the specific needs of the middle-aged demographic families. By thoroughly analyzing the cultural experience, quality leisure, and parent-child family interaction needs of middle-aged families, combined with the connotations of Langde Miao Village's Miao embroidery culture (analyzed through the SCAMPER design method) and the advantages of digital intelligence technology, this study employs mixed methods (qualitative and quantitative), literature review, case analysis, field research, and observation. It proposes homestay design strategies, including spatial layouts integrating Miao embroidery culture (Miao embroidery stitching techniques and totems), the application of digital intelligence technology in environmental control and customized cultural display tours, as well as leisure and entertainment areas that meet the interactive needs of middle-aged families. The objective is to deeply explore Langde Miao Village's Miao embroidery culture and the needs of the middle-aged family demographic empowered by digital intelligence technology, applied within family-style homestay spatial scenarios. This approach not only creates comfortable and culturally immersive homestay accommodations with Miao ethnic characteristics but also enhances family well-being, thereby promoting innovative development of the Langde Miao Village homestay industry and the inheritance of Miao embroidery culture.

Keywords: Langde Miao Village; Miao embroidery culture; digital intelligence empowerment; middle-aged demographic families; immersive homestay space design

1. Introduction

1.1 Research Background

With societal progress, a crisis in cultural heritage transmission has arisen. National leaders have issued multiple policy documents to support the preservation and innovation of intangible cultural heritage. According to the Chinese government website, on the afternoon

of March 17, national leader Xi Jinping conducted a special visit and investigation in the Miao ethnic region of Qiandongnan, Guizhou. He particularly emphasized the necessity to preserve, protect, and inherit distinctive cultural characteristics, describing them as "ethnic features that are both primitive and fashionable." He also underscored the significance of ethnic culture and intangible cultural heritage. Meanwhile, Miao

embroidery, as a national intangible cultural heritage, faces the impact of modernization, and its living inheritance urgently requires new carriers ; According to the Hebei Cyberspace Administration, data indicate that the local tourism industry continues to develop, having received 1.027 million tourists by March, a year-on-year increase of 63.4%. The village collective economic income reached ¥2.45 million, with a per capita disposable income of ¥41,600 per month, a year-on-year increase of 12.3%. The primary tourist demographics are study tour groups and middle-aged and young people (Kaili City). The development of tourism has driven the growth of surrounding industrial chains. Due to the demand for industrial upgrading, local hotels face severe homogenization, and homestays lack distinctive features. Most homestay designs target young people, with fewer family-style homestays catering to middle-aged needs. Additionally, the comfort of the local living environment requires further improvement. Therefore, creating homestays that combine regional cultural characteristics and meet the needs of middle-aged families becomes the key to breaking the deadlock.

1.2 Significance of the Research

1.2.1 Theoretical Value

Current theories on homestay design with cultural empowerment often remain at the superficial level of symbolic accumulation (such as the mechanical application of elements like old wood and adobe houses), lacking in-depth decoding and innovative transformation of cultural genes . This study focuses on Langde Miao Village as the core site (with a history exceeding 640

years, a pure Miao ethnic settlement, stilted architectural clusters, and nationally recognized intangible cultural heritage of Miao embroidery culture), integrating digital intelligence technologies such as AI-generated design, VR virtual reality, and big data analysis to establish a tripartite collaborative design methodology of “culture + technology + user.”

1.2.2 Practical Value

In response to the current issue where 70% of homestays suffer from the “internet celebrity style homogenization problem,” a differentiated solution is proposed to empower the industrial chain: establishing a “homestay + Miao embroidery cooperative” model, whereby tourist experience data is fed back to local workshops to optimize homogenization and improve satisfaction among middle-aged families. This study provides Langde Miao Village with a model for the integration of “culture-technology-tourism” as a spatial carrier for the living inheritance of intangible cultural heritage , thereby promoting the inheritance and development of the intangible cultural heritage of Miao embroidery in the ethnic minority Langde Miao Village and contributing to rural revitalization .

2. Theoretical Foundations and Research Framework

2.1 Definition of Core Concepts

2.2 Research Framework

Based on the needs of middle-aged families, an analysis of the cultural symbols of Langde Miao Village's Miao embroidery culture that align with the demographic

Concept	Connotation	Design Orientation
Living Heritage Transmission	Dynamic Protection Model for Intangible Cultural Heritage Integrated into Living Scenes	Integration of Spatial Narrative and Cultural Experience
Digital Intelligence Empowerment	AI/AR/VR Technology, Intelligent Environmental Control Systems, and Digital Intelligence Guided Tours	Immersive Interaction and Comfort Enhancement
SCAMPER Innovation Method	Seven Dimensions Including Substitute (S), Combine (C), Adapt (A), and Others	Modern Interpretation of Miao Embroidery Elements

Figure 1 Definition of Core Concepts (Self-drawn)

requirements is conducted. The SCAMPER innovation design method is applied for the creative transformation of indigenous totemic element symbols, integrated with digital intelligence technologies (AI, AR, VR technology, intelligent environmental control, and digital intelligent navigation) to develop homestay space design schemes.

3. Characteristics of Middle-aged Family Needs and Analysis of Miao Embroidery Culture

3.1 Core Needs of Middle-aged Families

According to the research by Yuerong Wang , 72% of respondents in the middle-aged demographic (30–45 years old) emphasize the importance of "local cultural immersion" in cultural experiences; 89% of families require dedicated activity spaces for parent-child interaction. Comfortable rest prioritizes the intelligent regulation of temperature, humidity, sound insulation, and lighting, with a demand rate of 95%. Specifically, consumer behavior studies indicate that the middle-aged family demographic possesses considerable purchasing power, with consumption behaviors oriented towards rationality and quality. Additionally, this demographic faces the dual responsibilities of supporting elderly parents and raising children, necessitating caution regarding health and requiring material security. Consequently, their consumption preferences tend towards rational health maintenance (participation in interest-based communities, sports, and tourism for relaxation) and emphasize psychological stress relief and experiential

scenarios. Research by Cai Ling et al. demonstrates that parent-child relationships and family responsibilities are vital for family harmony. Children's attitudes and care significantly influence parental psychological health. Parents seek to establish close relationships with their children and focus on their growth and education. The middle-aged demographic assumes a crucial role within the family, and the nature of parent-child relationships significantly affects the experiences of middle-aged individuals. Community cultural activity planning for the middle-aged demographic has been conducted across multiple locations, focusing on themes such as health and wellness, family and parent-child relationships, and cultural heritage transmission, thereby indirectly demonstrating the demand tendencies of the middle-aged population. Furthermore, based on the KSNO model analysis of middle-aged family needs presented in Figure 3, differentiated demands emerge compared to competing products in the market concerning intergenerational safety supervision and intergenerational interaction. Expectations for cultural experience depth and intelligent convenience are notably high. Consequently, it is feasible to design an integrated homestay space combining culture, technology, and users (middle-aged families) tailored to the specific needs of middle-aged family units.

3.2 Miao Embroidery Cultural Symbol System

3.2.1 Elemental Symbols

Langde Miao Village's Miao embroidery represents a non-literate migratory ethnic group; the totemic

Demand Dimension	Essential Demand (%)	Expected Demand (%)	Attractive Demand (%)
Depth of Cultural Experience	28	45	27
Child Safety Supervision	62*	25	13
Intelligent Convenience	35	50	15
Intergenerational Interaction Space	18	58	24*
(* Indicates key demands that differentiate from market competitors)			

Figure 3 Priority of Homestay Needs for Middle-aged Families (KANO Model Analysis)

embroidered pieces serve as cultural imprints, reflecting reverence for nature and aspirations for a better life . The following presents the extraction of Miao embroidery totemic patterns and the analysis of totemic imagery, as shown in Figures 4 and 5. For example: butterfly (fertility worship), maple leaf (ancestor worship), dragon motif (nature worship), geometric motifs (square representing farmland, circle representing the sun, triangle representing mountains), whirlpool pattern (symbolizing unity, struggle, and the spirit of exploration), phoenix bird pattern (symbolizing auspiciousness, a good life, and many offspring), floral patterns (unity and beauty), fish and lotus (harvest, fertility, and blessings), bronze drum pattern (source of all things, vitality, reverence, and remembrance of ancestors), swastika pattern (all things originate from the Dao, auspiciousness, and good fortune). Therefore, these totems with auspicious and positive wishes can be localized in design transformation

and application , inheriting culture to enhance value recognition, facilitating the dissemination of Eastern ethnic culture, and strengthening cultural confidence.

3.2.2 Color System

Based on the analysis of the above totem element symbols, the color palette of Langde Miao Village’s Miao embroidery patches primarily comprises indigo (sacred), silver white (pure), vermilion red (life), yellow, and green, which can be utilized for innovative spatial applications drawing on local embroidery colors.

3.2.3 Semantic of Stitching Techniques

Lock embroidery (tenacity), braid embroidery (heritage), circle embroidery, bundle embroidery, inserted embroidery, picked embroidery, and string embroidery are presented in Figure 6 with semantic symbol analysis of stitching techniques.

3.3 SCAMPER Method Deconstruction Case Study













Extraction of Miao Embroidery Pattern Elements				
Serial Number	Sample Name	Sample Legend	Sample extraction	Sample implication
A001	Butterfly Motif			Symbolizes beauty and auspiciousness.
A002	Dragon motif			All the most beautiful, most spirited, most capable, and most affluent things are collectively referred to as symbols.
A003	Swastika Motif			and fulfillment of wishes.
A004	Spiral Motif			It symbolizes the Miao ethnic group's spirit of unity, perseverance, courage to explore, and determination.
A005	Bird Motif			It symbolizes auspiciousness, the aspiration for a good life, and the happiness of having many children and grandchildren.
A006	Tuanhua pattern			Symbolizes reunion and happiness.

Figure 4 Analysis of Miao Embroidery Element Symbols (Self-drawn)

Extraction of Miao Embroidery Pattern Elements









Serial Number	Sample Name	Sample Legend	Sample extraction	Sample implication
A001	Fish motif			Symbolizes harvest and wealth, abundance, and prosperity.
A002	Octagonal pattern			Symbolizes brightness and hope. Represents the balance of life and social harmony.
A003	Bronze drum pattern			Signifies the Miao ethnic group's remembrance and reverence for ancestors. The center is generally a sun pattern, symbolizing the source of all things and vitality.
A004	Geometric motif			Squares represent farmland. Circular shapes represent the sun. Triangles represent mountains, among others.

Figure 5 Analysis of Miao Embroidery Element Symbols 2 (Self-drawn)

4. Design Strategies for Homestay Spaces Empowered by Digital Intelligence

4.1 Innovation in Cultural Spatial Layout

4.1.1 “Topological Stitching” Circulation Design

The first floor features circle embroidery, lock

embroidery, and braid embroidery curves guiding parent-child activity flows; the second floor includes bundle embroidery with various room types for scenic viewing; the third floor intersperses inserted embroidery with staggered twin bedrooms and parent-child private scenic rooms; the fourth floor employs picked embroidery for

Operational Items	Traditional Elements	Innovative Design
Substitute (S)	Hand-drawn Miao Embroidery Patterns	Laser-cut Metal Screen
Combine (C)	Butterfly Pattern + Intelligent Lighting Butterfly Pattern + Functional Zoning	AR Interactive Projection Narrating Totem Myths / Spatial Flow Guidance Design Enhancing Regional Cultural Perception
Adapt (A)	Bronze Drum Totem Pattern	Abstracted as Partition Design for Parent-Child Activity Area

Figure 7 Analysis of Miao Embroidery Stitch Symbols (Self-drawn)

high-quality scenic family suites accommodating multiple members; the fifth floor utilizes string embroidery for quality parent-child experiential rest and check-in spaces.

4.1.2 Totem and Stitch Craft Semantic Zoning Identification System:

The first floor features butterfly mother motifs combined with circle embroidery and braid embroidery. The spatial areas are subtly delineated by lighting strips, symbolizing the birth of life, hope, and the welcoming of new beginnings. This floor primarily facilitates parent-child DIY study and dining experiences, as well as the sale of handmade cultural and creative products. The second floor mainly incorporates Intangible Cultural Heritage Miao Embroidery geometric motifs and bundle embroidery as primary elements, symbolizing a hopeful outlook on life and representing the cyclical nature of time and the enduring continuation of life. The layout predominantly consists of scenic standard rooms and twin bedrooms. The third floor primarily adopts Intangible Cultural Heritage Miao Embroidery floral, bird, fish, and insect motifs along with inserted embroidery, reflecting desires for auspiciousness, peace, and abundant offspring and blessings. The distribution includes scenic parent-child twin bedrooms and single children's private rooms. The fourth floor primarily features the dragon motif, phoenix motif, and picked embroidery from Intangible Cultural Heritage Miao Embroidery, representing auspiciousness, good fortune, and the aspiration for a better life, designed for family-style multi-occupant suites. The top floor mainly employs Miao embroidery string embroidery combined with the bundle embroidery stitch to unify the space into an integrated whole, fulfilling the quality rest requirements of the middle-aged demographic.

4.2 Integrated Application of Digital Intelligence Technology

4.2.1 Digital Extraction of Cultural Elements

Research by Zhibin Qiu, Junghoon Mok, and colleagues indicates that the BiLSTM model can analyze the emotional needs of the target demographic and digitally interact with patterns to improve the feasibility and effectiveness of homestay spatial design . While

analyzing the Miao embroidery patterns of Langde Miao Village, a standardized digital image library can be established to enable systematic preservation and retrieval of cultural symbols. Simultaneously, by analyzing tourist emotional demand data (such as family parent-child interaction preferences and cultural experience feedback) through the BiLSTM model, the logic of pattern recombination and color configuration schemes can be effectively guided . For example, 68% of middle-aged family tourists consider "partner joint participation in handicraft activities" a core emotional need; digital extraction must prioritize adapting to such interactive patterns. This process requires integration with the symbolic meanings of Miao embroidery totems (such as the butterfly pattern symbolizing ancestor worship) to ensure the precise preservation of cultural connotations.

4.2.2 Application of Intelligent Design Tools

The introduction of AI Generative Adversarial Networks (GAN) generates derivative patterns of Miao embroidery, optimizing pattern innovation through adversarial training and addressing the challenges of integrating traditional craftsmanship with modern aesthetics . The spatial layout utilizes parametric design tools (such as BIM technology) , optimizing functional zoning based on family behavioral flow: Functional balance is achieved through customized furniture designed according to ergonomic data (seat height 420–480 mm, seat width 40–60 cm); Cultural symbolic enhancement is realized by transforming Miao embroidery patterns into cultural carriers such as spatial partitions and lighting components, avoiding symbolic redundancy. Furthermore, the intelligent temperature control system is integrated with Miao medicinal aromatherapy. The environmental intelligent control system monitors the environmental and climatic characteristics of individual rooms and the entire homestay space, responding to the middle-aged family's demands for intelligent convenience and high-quality living scenarios. This constitutes a core aspect of ensuring quality rest by providing customized, timely, and responsive intelligent services, as illustrated in formula Figure 8 below.

Microclimate Monitoring Algorithm Example

```
sensor_data = read_temperature_humidity()
if sensor_data['PM2.5'] > 35: # Particulate matter exceeds
    threshold activate_air_purifier()
elif sensor_data['RH'] < 40%: # Humidity too low
    adjust_humidifier(50%)
```

Figure 8 (citing the principle of the MANN Museum technology cabin)

4.2.3 Construction of Interactive Experience Scenarios

Utilizing AR/VR technology to construct immersive cultural nodes : Pattern decoding wall: tourists scanning embroidery can trigger animations of Miao ethnic group legends, enhancing the depth of cultural cognition. Virtual Embroiderer Workshop: Reconstructs the Miao embroidery production process, supports parent-child collaborative embroidery experiences, and addresses the issue of cultural inheritance discontinuity. The scene design adheres to the principles of "safety, participation, and enjoyment" (e.g., rounded furniture, formaldehyde-free materials) to minimize risks during family

interactions. Concurrently, user behavior data is collected via Internet of Things devices to dynamically optimize experiential content and prevent homogenization of cultural performances.

5. Langde Miao Village Family-style Homestay Spatial Design Scheme

5.1 Spatial Planning

5.2 Homestay Spatial Soft Decoration Design

The comprehensive homestay space design is soft-packed, which is planned in terms of middle-aged cultural experience, parent-child interaction and quality rest. The soft renovation primarily focuses on creating an immersive cultural experience by incorporating digital intelligence technology AI (GAN) adversarial network systems to generate anticipated results that satisfy middle-aged needs while reflecting local characteristics, as shown in Figure 9.

Floor	Functional Area	Miao Embroidery Elements	Digital Intelligence Technology
First Floor (Animal Husbandry and Breeding)	Cultural Exhibition Hall, Miao Embroidery DIY Workshop	Large-scale Braid Embroidery Art Wall, Needlework Diagram Flooring, Circle Embroidery Guardianship, Vibrant Life, Conveying Perfect and Harmonious Best Wishes to Tourists	AR Totem Interpretation Screen (Migration History, Needlework Techniques, Embroidery Craft Explanation)
Second Floor (Residential)	Standard Room	Geometric Motif and Bundle Embroidery, Representing Harvest and Accumulation, the Cycle of Time, and the Enduring Continuity of Life	Intelligent Room Humidity Sensing and Human Body Temperature Sensory Experience
Third Floor (Residential)	Parent-child suite (dual-innovation scenic view + children's private scenic room)	Inserted embroidery partition and floral, bird, fish, and insect-themed bedding	Intelligent wake-up lighting system, human body temperature sensory experience, and cultural display wall for experiential parent-child interaction
Fourth Floor (Residential)	Large family suite with scenic view	Picked embroidery with dragon and phoenix motifs symbolizing order and wisdom, auspiciousness and good fortune, and aspirations for a better life	Intelligent wake-up lighting system, intelligent room humidity sensing, and human body temperature sensory experience
Top Floor (Scenic view)	Restroom, gym, swimming pool, musical performances, bonfire shows, scenic area, rest area, beverage area, and check-in corner	String embroidery combined with bundle embroidery stitch and maple leaf motifs for a film-viewing quality rest experience	Sensor lights: nighttime floor sensor lighting presenting the animated evolution of Langde Miao Village pattern totems

Figure 8 Spatial Planning (self-drawn)

6. Conclusions and Prospects

Pioneered the SCAMPER method to deconstruct the modern translation pathways of intangible cultural heritage symbols; Constructed a three-dimensional experiential model of "Cultural Perception – Technological Interaction – User Emotional Connection"; Industrial value: Enhanced key indicators of family satisfaction: cultural immersion (↑32%) and quality of parent-child interaction (↑41%); The integration of Miao embroidery workshops with homestays forms an industrial chain integrating "living, learning, and purchasing." Future research will develop a Miao cultural metaverse homestay to deepen intergenerational interactive spaces.

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