Original Paper

Visual Symbol Analysis and Digital Reconstruction of Lujin Patterns

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Abstract

Lujin, a representative traditional hand-weaving craft from southwestern Shandong, embodies profound regional culture and the wisdom of folk art. With the acceleration of industrialization and digitalization, this form of intangible cultural heritage (ICH) faces challenges of both preservation and innovation. Adopting perspectives from visual semiotics and digital design, this study focuses on typical Lujin patterns, analyzing their visual-symbolic characteristics and cultural connotations, and exploring pathways for their digital reconstruction. Based on the analytical framework of "symbolic interpretation–digital reconstruction," the paper establishes a comprehensive system for interpreting Lujin's visual symbols and proposes three reconstruction principles: preservation of cultural genes, alignment with contemporary aesthetics, and adaptation to digital media. Through vector-based modeling and motion-graphics experiments, the study verifies the feasibility of this approach. The results indicate that digital reconstruction not only contributes to the preservation and transmission of Lujin's visual identity but also provides new directions for integrating traditional craftsmanship into contemporary design practices.

Keywords

lujin patterns, visual symbol, digital reconstruction, intangible cultural heritage, cultural innovation

1. Introduction

The Lujin weaving craft, originating from the southwestern region of Shandong Province, constitutes an important component of China's traditional textile culture. It is renowned for its rich geometric patterns, vibrant colors, and delicate craftsmanship, and was inscribed on China's National List of Intangible Cultural Heritage in 2008. More than a handcraft, Lujin functions as a visualized cultural symbol system that records the lived experiences, aesthetic values, and spiritual beliefs of local communities. However, under the impact of industrialization and globalization, the ecological environment for traditional

handicrafts has been severely constrained. The practical functions of Lujin have gradually declined, the number of inheritors has diminished, and technical discontinuity has emerged, placing its unique visual-symbol system at risk of disappearance.

In the digital era, the methods and concepts of intangible cultural heritage protection have undergone profound transformation. Digital technology provides new possibilities for preserving, disseminating, and reinterpreting traditional crafts. Protection is no longer limited to the physical conservation of artifacts but extends toward living transmission and creative transformation. As a key carrier of regional culture, Lujin patterns demand re-examination: how can these traditional visual symbols be reinterpreted, reconstructed, and revitalized through digital media? Unlike static archiving, digital reconstruction aims to extend the cultural vitality of traditional symbols through contemporary technological means, enabling them to be continuously used, experienced, and reimagined in modern contexts.

Current research on Lujin and related traditional patterns can be grouped into two main directions. The first focuses on the classification of weaving techniques, materials, and stylistic characteristics, emphasizing the craftsmanship and morphology of patterns. The second concerns digital preservation and design innovation, exploring data collection, digital modeling, and reuse of traditional motifs. However, most existing studies remain at the technical or formal level and lack a comprehensive cultural-symbolic interpretation of Lujin's visual system. While international scholarship in information visualization and semiotics provides useful methodological references for the digitalization of traditional patterns, a systematic framework suited to Lujin's unique cultural context has yet to be established.

This study therefore takes Lujin patterns as the core object of analysis, integrating theories of visual semiotics to explore their morphological logic, cultural meaning, and pathways of digital reconstruction. The research seeks, through the dual approach of "symbolic analysis and digital transformation," to reveal the intrinsic mechanisms of Lujin's visual language, and to establish a model of digital conversion that combines theoretical depth with design operability. Ultimately, it aims to provide methodological references for the contemporary inheritance and innovative development of traditional crafts.

2. Visual Symbol Analysis of Lujin Patterns

2.1 Analytical Framework of Visual Symbols in Lujin Patterns

In terms of morphological characteristics, Lujin patterns are distinguished by their geometric construction. The interlacing of warp and weft in the weaving process determines the predominance of straight lines and regular shapes such as squares, diamonds, and hexagons, which together establish a rigorous visual order. Representative motifs such as the "Turtle-Back Pattern," the "Octagonal Medallion," and the "Hedou Pattern" originate from the observation of natural forms while reflecting artisans' capacity for abstraction. This process of "deriving form from objects and transforming imagery into pattern" embodies the traditional Chinese philosophy of guan wu qu xiang (observing nature to extract symbolic form), through which natural imagery acquires new layers of cultural meaning.

In the use of color, Lujin patterns inherit the traditional aesthetic concept of the Five Colors—blue-green, red, yellow, white, and black—and combine it with natural plant-based dyes to create a unique regional palette. Red symbolizes joy and abundance, blue represents calmness and reason, and yellow connotes dignity and prosperity. Artisans achieve visual harmony by contrasting dominant and auxiliary hues, balancing warm and cool tones, and manipulating lightness and saturation. The result is an expressive system of color that appears simple yet vibrant, revealing the precision and sensibility of folk aesthetic logic.

Culturally, Lujin patterns are closely linked to local customs, beliefs, and daily life. Beyond mere decoration, they function as carriers of emotion and spiritual aspiration. For instance, the "Fish-Eye Pattern" expresses wishes for fertility and prosperity; the "Endless Knot Pattern" symbolizes continuity and longevity; and the "Water-Wave Pattern" represents financial abundance and the cyclical flow of life. The popularity of these motifs reflects shared cultural values—harmony, happiness, and prosperity—deeply rooted in the daily experience of the community.

Thus, the symbolic system of Lujin patterns takes geometric structure as its formal foundation, color order as its emotional expression, and cultural symbolism as its spiritual core. It demonstrates both the rational order of folk aesthetics and the warmth of lived experience, providing a clear analytical basis for subsequent studies on digital reconstruction.

2.2 Morphological Characteristics and Structural Principles

Over centuries of development, Lujin has evolved a stable geometric system and a distinct aesthetic style. Its formal structure, while constrained by weaving techniques, also reflects the creativity and perceptual intelligence of folk artisans. The following representative patterns illustrate its structural principles and formal beauty.

Octagonal Medallion Pattern: This pattern is based on a regular octagon with equal sides and precise angles, forming a symmetrical and stable composition. The eight modules radiate outward from a central point, symbolizing auspiciousness and the harmony of "all directions in unity." The color scheme, dominated by indigo with reddish-brown outlines and off-white fillers, produces a balanced tonal transition through layered dyeing, resulting in a dignified and tranquil visual effect.

Turtle-Back Pattern: Inspired by the texture of a turtle shell, this motif is composed of tightly interlocking hexagonal cells that form a continuous mesh-like structure symbolizing longevity and stability. Artisans enhance visual depth by subdividing the pattern into smaller triangles, and the repetitive, symmetrical arrangement generates rhythmic continuity. The use of indigo in varying concentrations, with subtle accents of brownish red, creates nuanced tonal variation while maintaining overall harmony.

Jujube-Flower Pattern: This motif abstracts the natural form of the jujube blossom into a geometric configuration. A circular center is surrounded by five triangular petals arranged radially, yielding a concise and balanced structure. The red and yellow contrast evokes festivity and vitality, while the deliberate spacing between petals and the center introduces visual "breathing room," enhancing the decorative appeal and spatial rhythm.

Water-Wave Pattern: Composed of regularly aligned undulating lines, the pattern balances geometric order with organic flow. The equal spacing and consistent amplitude of wave crests and troughs represent natural harmony and continuity. Variations of indigo tones simulate the shimmering of water, while touches of light yellow depict reflective highlights. The design conveys a sense of perpetual motion, symbolizing enduring vitality and fortune.

Hedou Pattern: Formed by interlacing squares and diamonds, the Hedou pattern features strong, well-defined lines and a clear structural hierarchy. Mirror symmetry ensures visual balance, while repetition and rotation generate rhythm and order. The red-and-yellow palette follows the folk color principle that "red paired with yellow brings brightness," producing an image that is both warm and festive.

From the analysis above, the visual appeal of Lujin patterns arises from the interplay between structural rationality and emotional expression. The geometric construction reflects technical logic and proportional awareness; repetition builds visual rhythm and stability; and layering—through the coordination of form, color, and detail—creates a sense of spatial depth. Together, these features embody a harmony of order and warmth that defines Lujin's unique visual identity. This formal system, rooted in empirical craft wisdom, provides measurable and transferable parameters for its future digital reconstruction.

2.3 Cultural Connotations and Visual Implications

Lujin patterns represent more than ornamental design; they are a visual language that documents social culture. They encapsulate the lived experiences, spiritual beliefs, and aesthetic sensibilities of the people of southwestern Shandong, serving as an enduring visual archive of regional culture.

From the perspective of natural imagery, many Lujin motifs are derived from local flora and fauna. The "Wheat-Sprout and Bamboo-Joint Pattern" uses interwoven lines to depict the rhythm of crop growth, symbolizing fertility and renewal. The "Plum-Blossom Pattern" embodies the Five Blessings—longevity, wealth, health, virtue, and peace—while the "Fish-Eye" and "Goose-Eye" patterns express desires for prosperity and harmony. These motifs translate observations of nature into symbolic expressions, exemplifying the folk capacity to transform lived experience into art.

From the perspective of history and folklore, certain motifs carry specific cultural memories and communal narratives. The "Maze Formation Pattern" (Mihun Zhen) originates from the legend of General Sun Bin's military formations during the Warring States period and signifies intelligence and strategic wisdom. Its intricate geometry also demonstrates artisans' technical mastery. The "Water-Wave" and "Lantern" motifs, frequently used in wedding and birth celebrations, symbolize wealth, continuity, happiness, and reunion, functioning as essential visual symbols in local ritual practices.

At the level of philosophical thought, Lujin patterns reflect the Confucian ideal of zhong he—moderation and harmony. Their compositions emphasize symmetry, balance, and order, expressing an aesthetic pursuit of equilibrium and propriety. The color schemes highlight contrast within unity, illustrating the concept of he er bu tong ("harmony without uniformity"). This visual order mirrors the moral and social values of the community, transforming abstract ethics into perceptible artistic form.

The cultural value of Lujin patterns lies in their integration of natural imagery, collective memory, and ethical ideals into a coherent system of visual symbols—an "artistic embodiment of lived experience." These motifs not only possess aesthetic significance but also serve as vehicles for cultural inheritance, offering both conceptual and spiritual resources for the creative revitalization of traditional crafts in contemporary contexts.

3. Digital Reconstruction Practice of Lujin Patterns

3.1 The Logic and Principles of Digital Visual Reconstruction

The digital reconstruction of Lujin patterns represents an essential pathway for revitalizing traditional craftsmanship in contemporary contexts. Its core logic lies in applying digital technologies to re-encode the morphological structures, color systems, and cultural imagery inherent in traditional weaving, thereby transforming material textile patterns into visual symbols within digital media. This process is not a mechanical replication but a creative translation grounded in cultural understanding, allowing traditional art to be perceived and disseminated through new modes of visual communication.

The overall framework of digital reconstruction can be summarized in three progressive dimensions: cultural inheritance, visual translation, and innovative dissemination. Cultural inheritance emphasizes the accurate preservation of the formal rules and cultural meanings of Lujin patterns, ensuring the authenticity of traditional symbols during digital transformation. Visual translation involves parameterizing and visualizing pattern structures through digital tools, enabling traditional motifs to be recognized and reconstructed across multiple digital platforms. Innovative dissemination utilizes emerging media—such as animation, interactive design, and digital exhibitions—to give traditional patterns new expressive and communicative spaces in modern society. These three dimensions reinforce one another, forming the logical foundation of Lujin's digital reconstruction.

3.1.1 Principle of Cultural Gene Preservation

Preserving cultural genes is both the foundation and the ethical boundary of digital reconstruction. The value of Lujin patterns lies in their embedded regional identity and symbolic meanings; thus, their essential morphology, proportions, and color attributes must be faithfully maintained in the digital process. For instance, the octagonal symmetry of the Eight Medallions Pattern and the hexagonal lattice of the Turtle-Back Pattern are structural elements fundamental to Lujin's visual identity and should be precisely reproduced through parameterized modeling. Traditional plant-based dyes—such as indigo, madder red, and gardenia yellow—should be digitized by establishing standardized color databases to preserve their authentic chromatic characteristics. Cultural gene preservation is not merely a technical restoration of form but a continuation of cultural spirit, ensuring that digital outcomes retain both artistic integrity and cultural recognizability.

3.1.2 Principle of Contemporary Aesthetic Alignment

Digital reconstruction goes beyond restoring traditional motifs; it aims to reinterpret them within contemporary visual systems. Designers should, while respecting tradition, adjust elements such as line

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quality, color contrast, proportion, and rhythm to align with modern aesthetic sensibilities. For example, in digital interface design, intricate traditional patterns can be simplified, their lighting and shadow effects enhanced, and their tonal contrast optimized to achieve clarity and adaptability. Through such refinement, Lujin's visual symbols gain renewed accessibility and emotional resonance within today's media environments, achieving an authentic contemporary expression of traditional aesthetics.

3.1.3 Principle of Digital Media Adaptation

The dynamic, interactive, and spatial characteristics of digital media provide possibilities for expressions that transcend the limitations of two-dimensional surfaces. In design practice, the specific attributes of each medium should be fully utilized to explore innovative modes of presentation. For instance, the Water-Wave Pattern can be animated through algorithmic simulation to reproduce fluid motion, imbuing static images with temporal dimensions. In interactive displays, user gestures can trigger variations in the pattern, fostering real-time interaction between audiences and cultural content. Within virtual reality spaces, Lujin patterns can be reconstructed as immersive environments, transforming traditional motifs into multisensory experiences. By employing digital media, Lujin patterns evolve from woven artifacts into information-based imagery, expanding their expressive potential in the digital age.

The digital reconstruction of Lujin patterns should therefore be understood as cultural extension rather than formal substitution. Cultural gene preservation safeguards the essence of tradition; aesthetic alignment expands its communicative scope; and media adaptation endows it with new expressive dimensions. Together, these principles enable Lujin to evolve from a static heritage object into a dynamic cultural resource within the digital ecosystem.

3.2 Technical Pathways and Design Practice of Digital Translation

The digital translation of Lujin patterns refers to the reinterpretation of traditional visual symbols within digital media. Its core objective is to achieve a methodological transformation from manual weaving to digital visualization, ensuring both preservability and creativity. The process can be divided into two complementary levels: vector-based precision reconstruction and narrative motion expression. The former emphasizes data standardization and formal accuracy, while the latter highlights temporality, interactivity, and emotional expression.

3.2.1 Vector-Based Precision Reconstruction

Vector reconstruction serves as the technical foundation for digital translation, aiming to convert Lujin motifs into editable and scalable digital resources.

The first step, pattern analysis, involves high-resolution scanning and image measurement to extract the geometric proportions, line orientations, and symmetry rules of each motif. For example, the octagonal ratios and structural relationships of the Eight Medallions Pattern are digitally recorded for modeling accuracy.

The second step, form refinement, uses vector-design software to deconstruct complex motifs into layered structures, extracting their core geometric frameworks—such as the hexagonal lattice underlying the Turtle-Back Pattern.

The third step, digital reconstruction, translates traditional dyeing logic into a standardized digital color system. The hues of natural dyes are converted into RGB or CMYK values to create a color database, ensuring chromatic consistency across various media platforms.

Through this process, the morphology, proportion, and chromatic system of Lujin patterns are accurately digitized and preserved. Vector-based modeling thus establishes a robust technical foundation for dynamic design, enabling cross-platform utilization and sustainable pattern innovation.

3.2.2 Narrative Motion Expression

Unlike static preservation through vector modeling, motion graphics introduce temporal and narrative dimensions, allowing traditional imagery to convey rhythm, emotion, and symbolism through movement.

During the form deconstruction stage, designers break down static patterns into independently animatable components, creating layered hierarchies for animation. For instance, in the Jujube-Flower Pattern, petals, core, and background layers are separated to control their respective motions.

In the motion definition stage, animation logic is designed in accordance with symbolic meaning: the blooming of petals in the Jujube-Flower Pattern represents vitality; the Water-Wave Pattern employs waveform algorithms to illustrate perpetual flow; and the Hedou Pattern expands radially to express order and harmony.

Finally, the rhythm control stage adjusts timing curves and frame rates to align visual motion with emotional tone. For example, slow and continuous movement in the Water-Wave Pattern conveys serenity and continuity, while gradual acceleration in the Jujube-Flower Pattern symbolizes dynamic growth.

Motion graphics enable Lujin motifs to transcend the limitations of static textiles, transforming them into dynamic visual narratives that engage both perception and emotion.

3.2.3 Comprehensive Value of Digital Translation

The digital translation of Lujin patterns signifies not only technological innovation but also the extension of cultural logic. Vector modeling ensures structural and chromatic standardization, while motion graphics introduce emotion and temporality, jointly establishing a complete framework for "symbolic analysis to visual regeneration."

Digitization greatly expands the application scope of Lujin patterns. Their digital assets can be integrated into cultural and creative industries, visual media, interactive installations, and educational platforms, promoting the active transmission of traditional art. As a result, Lujin is no longer confined to handcrafted textiles but has evolved into a cultural symbol embodying the visual language of the digital age—bridging traditional craftsmanship and contemporary design culture.

4. Conclusion

This study takes Lujin patterns as its research focus and systematically explores the transformation and revitalization of traditional crafts in contemporary contexts—from visual-symbol analysis to digital reconstruction. Through detailed examinations of morphological structure, compositional logic, and

cultural symbolism, the research reveals the artistic principles underpinning Lujin's geometric order, rhythmic repetition, and layered composition. It also elucidates the delicate balance between structural rationality and emotional expressiveness. Building upon these findings, the study proposes three guiding principles—cultural gene preservation, alignment with contemporary aesthetics, and digital media adaptation—and establishes a dual-structured technical path combining vector-based reconstruction and motion-graphic design, verified through practical case studies. The results demonstrate that digital technology can not only preserve the morphological and chromatic characteristics of Lujin patterns with precision but also endow them with renewed visual vitality through dynamic and interactive expression. The digital reconstruction of Lujin patterns embodies the regeneration mechanism of traditional culture in modern society. It represents not merely technological progress but a renewal of cultural transmission. Digital technology provides new methodologies for the protection and reinterpretation of intangible cultural heritage, transforming traditional crafts from static exhibits into dynamic cultural experiences and from localized folk art into globally communicable visual language. Future research may further integrate emerging technologies such as AI-generated content (AIGC) and virtual reality to expand the application and dissemination of Lujin patterns. By constructing a more open and interactive digital cultural ecosystem, traditional craftsmanship can continue to thrive and evolve, sustaining its vitality within the digital era.

References

Liu, F., & He, R. (2025). Regenerative design and application of Lujin patterns from the perspective of deconstructionism. *Design*, *38*(7), 80-84.

Munzner, T. (2014). *Visualization analysis and design*. A. K. Peters/CRC Press. https://doi.org/10.1201/b17511

Ware, C. (2019). *Information visualization: Perception for design* (4th ed.). Morgan Kaufmann.

Xu, X., & Guo, Y. (2024). Research on the weaving restoration and digital communication of classic Lujin patterns. *China National Exhibition*, *24*, 57-59.

Zhang, Y., & Li, H. (2025). Research on the historical and artistic value and inheritance development of Lujin. *Liaoning Silk*, *4*, 12-13.