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EXTRACTION AND INTERPRETATION OF ETHNIC PATTERN ELEMENTS USING DIGITAL TOOLS

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This study examines the digital extraction and interpretation of ethnic pattern elements in the context of cultural preservation and contemporary design. It analyzes how segmentation techniques, structural analysis, and generative models contribute to pattern reconstruction and reinterpretation. A framework of “structural extraction–semantic reconstruction–design translation” is proposed. Findings indicate that deep learning segmentation and diffusion models enhance structural recognition and texture reconstruction, while semantic networks support cultural representation. Digital processing and textile mapping further enable material translation in modern design. Digital tools thus provide an effective pathway for both preservation and innovative application of ethnic patterns.

Key words: ethnic patterns; digital extraction; structural interpretation; generative models; digital design

INTRODUCTION

Digital technology has become central to cultural heritage preservation and contemporary design innovation. Ethnic patterns, as carriers of symbolic and historical meaning, face challenges in transmission and adaptation due to declining traditional craftsmanship and limited application contexts.

Recent research demonstrates advances in digital reconstruction of traditional motifs. Diffusion-based models achieve high-fidelity reconstruction of Cantonese embroidery styles (Rao et al., 2026). The AR-Net model enables precise segmentation of complex batik patterns, improving structural extraction (Wang et al., 2025). Digital archival frameworks further establish a pathway of digitization, generation, and application in textile design (Li, 2026).

Image processing and Jacquard mapping illustrate how ethnic motifs can be translated into woven textile structures (Wang, 2025). Semantic networks and dynamic shape grammar systems allow computational representation of cultural genes (Yang et al., 2025). At a broader level, digital technology reshapes contemporary fashion design language (Lee & Suh, 2024).

Thus, research has moved from digital reproduction to structural and semantic reinterpretation. This study analyzes how digital tools support the extraction and interpretation of ethnic pattern elements.



PURPOSE

This study explores how digital tools facilitate the extraction and interpretation of ethnic pattern elements. It aims to:

1. Examine digital segmentation and structural extraction methods;
2. Analyze generative models in pattern reinterpretation;
3. Investigate digital translation of ethnic patterns into contemporary design contexts.

A technical framework of “digital extraction–structural interpretation–design translation” is proposed.

RESULTS AND DISCUSSION

1. Digital Structural Extraction

Ethnic patterns often exhibit complex hierarchies and abstract forms. Manual tracing lacks precision and reproducibility. Deep learning segmentation methods effectively identify intricate boundaries and details, enabling accurate structural extraction (Wang et al., 2025).

Diffusion-based models further reconstruct contours, color, and texture under structural constraints, overcoming limitations of traditional modeling (Rao et al., 2026). Digital extraction therefore evolves into an integrated process of structural recognition and texture reconstruction.

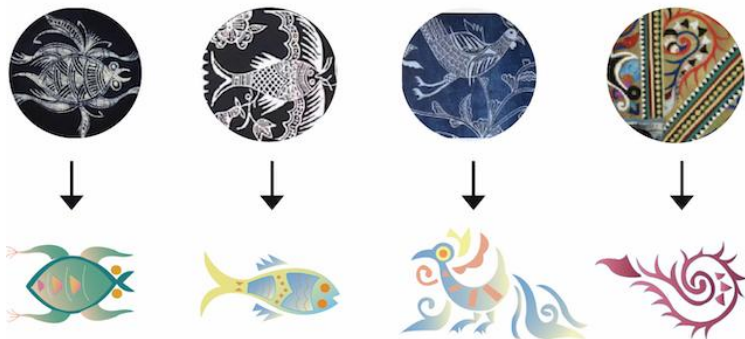


Fig. 1. Digital extraction and vector reconstruction of Miao ethnic pattern elements. The upper row presents original traditional motifs, while the lower row shows digitally simplified vector forms generated through structural extraction.

As shown in Fig. 1, original embroidery motifs are digitally extracted and reconstructed into simplified vector elements, illustrating the transition from traditional forms to structured digital representations.

2. Semantic Reconstruction and Generative Interpretation

Ethnic patterns function as symbolic systems beyond visual forms. Embroidery semantic networks and rule-based modeling enable structured representation of cultural elements (Yang et al., 2025).



Generative models produce novel pattern variations while maintaining stylistic consistency with traditional sources (Li, 2026). Digital interpretation thus involves structural extraction, semantic mapping, and controllable generation.

3. Translation into Contemporary Design

Modern application requires translation across materials and production systems. Color clustering and Jacquard mapping enable transformation from two-dimensional imagery to woven textile structures (Wang, 2025).

Digital technology reshapes pattern language and material expression in fashion design (Lee & Suh, 2024). Ethnic pattern reinterpretation therefore supports both cultural continuity and contemporary innovation.

Overall, digital tools operate through three pathways:

1. Structural extraction
2. Semantic reconstruction
3. Material and contextual translation

CONCLUSIONS

This study demonstrates that digital technologies significantly enhance the extraction and reinterpretation of ethnic pattern elements. Deep learning segmentation and diffusion models improve structural and textural reconstruction. Semantic networks support structured cultural representation, while digital textile mapping enables contemporary application.

Digital tools therefore function not only as preservation instruments but also as drivers of innovation, allowing ethnic patterns to evolve within modern design contexts.

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