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BASED ON CHINESE MIAO EMBROIDERY PATTERNS : AN INNOVATIVE APPROACH TO DIGITIZED DESIGN

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This research focused on analyzing Miao embroidery's traditional patterns and applying shape grammar and style transfer algorithms for innovative design. The integration of digital technology enabled the rapid creation of patterns that blend modern aesthetics with ethnic traits. Findings reveal that this digital integration boosts pattern update efficiency and market alignment. This method updates Miao's embroidery design by combining traditional craftsmanship with modern market trends.

Key words: Miao embroidery, pattern innovation, digital, shape grammar, style transfer algorithm.

INTRODUCTION

Miao embroidery, also known as the "history book without words," is a traditional embroidery art passed down through generations among the Miao people. With its vivid and straightforward modeling, full composition, bright colors, strong contrasts, and delicate texture, Miao embroidery possesses a high modern artistic value. The content, color, and shape of Miao embroidery offer diverse references for the development of contemporary design arts, yet its profoundness is challenging to replicate. Facing challenges like skill erosion, market misalignment, aesthetic decline, production inefficiencies and industrial decline, Miao embroidery's future hangs in the balance. This paper posits that the survival and revitalization of Miao embroidery can be achieved through digital technology. By marrying traditional Miao patterns with digital design methods and contemporary artistic expressions, the research aims to foster innovative designs in home decor, enhancing the utility and market relevance of Miao embroidery.

PURPOSE

To safeguard and perpetuate the intangible cultural heritage of the Miao people, and to ameliorate the issues of subjectivity in the Design process, this paper introduces an innovative method for Miao embroidery design elements based on shape grammar and style transfer algorithms. By deconstructing, reorganizing, and extrapolating the Miao embroidery design elements and integrating them into the design of cultural creative products, this study explores viable perspectives and strategies for the preservation, innovation, and development of Miao embroidery,

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thereby aligning with the shifts in contemporary socio-economic development and consumer demands. The ultimate goal is to create cultural creative products of Miao embroidery that absorb ethnic cultural essence and promote industrial transformation and sustainable development of craftsmanship.

RESULTS AND DISCUSSION

This article primarily utilizes two digital pattern derivation methods—shape grammar and style transfer algorithms—which both employ digital computational logic to evolve the shape of the target pattern through design techniques [1].

Shape Grammar is a computer-aided design and production system, initially proposed by Stiny et al. in the 1970s for painting and sculpture creation [2]. Subsequently, this method has been expanded to architecture, interior design, and product innovation, employing aesthetic principles and geometric composition rules to manipulate and combine basic shape elements using computer programs, thereby generating new design schemes. This method is also applicable to the innovative production design of Miao embroidery patterns. Traditional pattern creation often relies on the subjective imagination and manual expression of designers or professionals, which is not only inefficient but also demands high professional skills. In contrast, shape grammar automates the arrangement, rotation, mirroring, shearing, or positional changes of patterns through computer programs, following aesthetic and geometric rules, efficiently organizing, filtering, and recombining graphic elements [3]. This approach boosts efficiency, shortens design cycles, and maintains the cultural integrity of Miao embroidery. Shape grammar enables the creation of patterns that blend tradition with modernity, supporting cultural preservation and design innovation. It enables the rapid generation of diverse product design schemes, meeting user demands for personalized and innovative products [4].
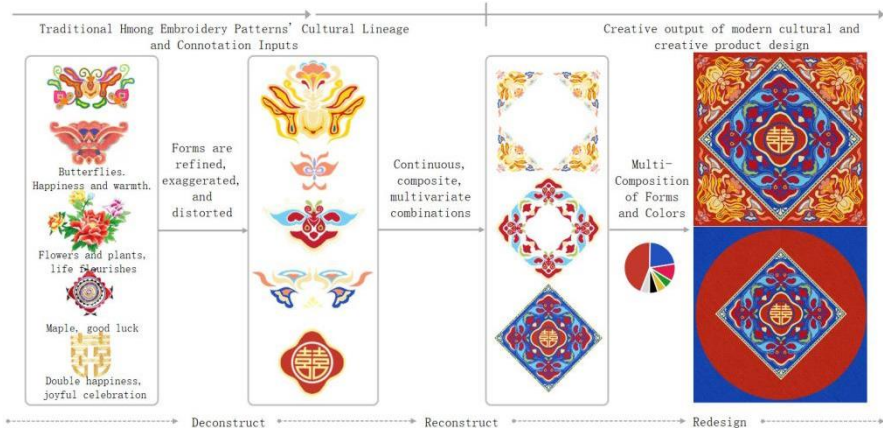

Fig.1. Innovative design of Miao embroidery pattern

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Miao embroidery features full compositions, rich decorations, clear layers, and well-balanced dispersion, generally categorized into main motifs, corner patterns, and dividing patterns. The first step involves selecting the most typical Miao embroidery patterns—butterfly patterns symbolizing happiness and auspiciousness, flora patterns representing abundant life, maple patterns denoting good fortune and happiness, and double happiness patterns expressing joy and celebration. These are then exaggerated, and transformed to derive simplified pattern results. In the second step, shape grammar is used for graphic evolution, based on the traditional Miao embroidery's balanced symmetrical layout and full pictorial rules, combined with translation replication, rotation, vertical mirroring, and horizontal mirroring, the four deductive methods in shape grammar. Finally, referencing the common compositional forms of Miao embroidery, the generated graphic units are adjusted and combined to form new Miao embroidery patterns. In terms of color filling, the classic Miao embroidery color scheme of "red as the base, blue as the main, and yellow-green as the auxiliary" is used, resulting in auspicious and joyous patterns with vivid colors, as shown in (Fig.1).

The style transfer algorithm, introduced by Gatys et al. in 2015, uses deep learning to blend the content of one image with the style of another, creating new visuals with unique textures, colors, and contours [5]. This method can separate and analyze image features, combine them in different proportions, and reconstruct new style graphics, extending its application in artistic design.

Sample Content Images	Sample Style Pictures	Style Analog Pictures	Design Application Product Pictures

Fig.1. Style Migration Algorithm Generates Image Process

For Miao embroidery, updating and creating patterns is traditionally slow and labor-intensive, limited mainly to local textiles. Using the style transfer algorithm, Miao patterns can be infused with diverse artistic styles, quickly producing innovative graphics and enhancing their visual appeal and marketability. This integration also allows traditional Miao aesthetics to connect with contemporary trends, injecting new life and perspective into the heritage and innovation of Miao culture.

Currently, programs developed using the style transfer algorithm are relatively mature and widely applied. For example, the photo editing software Ostagram, developed using neural network and artificial intelligence technologies, effortlessly transfers any artistic style onto corresponding images, enriching ordinary photos with varied artistic effects. This paper selects pattern motifs deduced by shape grammar as content image samples and chooses two pictures

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with distinctive artistic features, "Cubist Art" and "Church Stained Glass," as style image samples in Ostagram. By adjusting the parameters of stylization scale and intensity, the software generates style-simulated images that integrate Miao embroidery patterns with other artistic characteristics. Ultimately, the created patterns are applied to products like cushions and backpacks, which, while retaining the context and essence of traditional Miao embroidery patterns as seen in Table 1.

CONCLUSIONS

Integrating Miao embroidery with digital methods is essential for its preservation and modernization. Utilizing shape grammar and style transfer algorithms, this approach innovates while maintaining cultural authenticity. This synergy boosts design efficiency and generates innovative patterns that merge tradition with modernity, thereby streamlining the creative process. Advancements in digital technology promise continuous innovation in Miao embroidery, adding new global cultural and economic dimensions to traditional crafts. Consequently, merging traditional Miao embroidery techniques with modern digital methods is crucial for developing Miao cultural products and serves as a model for rejuvenating traditional crafts globally.

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ВАН Ш., КОЛОСНІЧЕНКО О.
НА ОСНОВІ КИТАЙСЬКИХ ВІЗЕРУНКІВ ВИШИВКИ МІАО: ІННОВАЦІЙНИЙ ПІДХІД ДО ОЦИФРОВАНОГО ДИЗАЙНУ

Це дослідження було зосереджене на аналізі традиційних візерунків вишивки Мяо та застосуванні граматики форми й алгоритмів перенесення стилю для інноваційного дизайну. Інтеграція цифрових технологій уможливила швидке створення візерунків, які поєднують сучасну естетику з етнічними рисами. Результати дослідження показують, що така цифрова інтеграція підвищує ефективність оновлення візерунків та їхню відповідність ринковим потребам. Цей метод оновлює дизайн вишивок Мяо, поєднуючи традиційну майстерність із сучасними ринковими тенденціями.

Ключові слова: вишивка Мяо, інновації візерунків, цифрові технології, граматика форми, алгоритм передачі стилю.