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PATTERN REVITALISATION DESIGN FOR TEXTILE MUSEUM SOUVENIRS IN THE CONTEXT OF DIGITAL TWINS

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This paper explores a pattern revitalisation design methodology within the digital twin paradigm to address issues such as the severe homogenisation of textile museum souvenirs and the underutilisation of traditional pattern resources. By constructing digital twins of traditional motifs and implementing a three-step strategy of "extraction-mapping-regeneration", it achieves a paradigm shift from static preservation to dynamic regeneration of cultural resources, thereby providing a systematic pathway for museum cultural and creative product development.

Keywords: Digital Twin; Textile Museum; Souvenir Design; Pattern Revitalisation; Cultural Translation.

INTRODUCTION

Museum souvenirs serve as key intermediaries linking collections to daily life, yet textile museum merchandise currently suffers from severe homogenisation and superficial cultural content. Many products merely replicate traditional patterns without exploring their inherent logic, resulting in "form without spirit" and failing to meet contemporary expectations.

Digital twin technology offers a solution. Originating in manufacturing, it creates virtual representations of physical entities for dynamic management. Applied to textile museums, it enables systematic deconstruction of patterns into retrievable digital elements, supporting reconfiguration and cross-media applications. This represents not mere replication, but "animated" thinking – preserving cultural authenticity while enabling contemporary reinterpretation, thus addressing both preservation needs and design innovation[1].

PURPOSE

This study aims to explore pathways for revitalising traditional patterns from textile museum collections and innovative souvenir design methodologies enabled by digital twin technology. Specifically, it encompasses: Firstly, constructing digital twins of textile artefact patterns to establish a retrievable, derivable pattern element library and a parametric rule repository, thereby achieving digital design translation of cultural resources; Secondly, proposing an "Extraction-Mapping-Regeneration" pattern revitalisation design model to transcend the superficial replication of artefact



patterns in traditional souvenirs, thereby forming a systematic methodology that balances cultural authenticity with contemporary aesthetics; Thirdly, validating the efficacy of this approach through design practice to provide textile museums with actionable technical pathways and design paradigms for cultural and creative product development. Ultimately, this will drive a paradigm shift in museum collection management from static preservation to dynamic regeneration, enhancing the cultural added value and market competitiveness of souvenirs.

RESULTS AND DISCUSSION

This study employs a design-based intervention methodology, taking traditional Chinese textile patterns as its subject matter. It constructs a digital twin-driven pattern revitalisation design process and validates its applicability in the development of museum souvenirs.

First, complete the construction of the digital twin. Employ ultra-high-definition planar scanning and microphotography techniques to capture surface texture and craftsmanship data of textiles. Utilise image processing software to extract pattern units, establishing a pattern gene library containing core elements such as geometric motifs, botanical designs, and animal patterns; concurrently record colour parameters and weaving density data to form quantifiable digital archives. Building upon this foundation, parametric tools are employed to translate pattern structures into adjustable rules – such as symmetry modes, rotation angles, density gradients, and nesting hierarchies – to construct a three-dimensional digital twin that dynamically integrates form, colour, and texture.

Pattern revitalisation design practice based on constructed digital twins implements a three-step revitalisation strategy: extraction, mapping, and regeneration. The extraction phase primarily deconstructs the cultural semantics of the original patterns, clarifying their symbolic meanings and cosmological expressions. The mapping phase preserves the identifying characteristics of core symbols while liberating restrictive parameters – transforming fixed compositions into modular units that enable the patterns to scale, rotate, rearrange, extend, and nest with variation. The regeneration phase generates differentiated solutions for diverse souvenir carriers: flexible material products employ dynamic compositions to transcend traditional layouts; rigid ornaments extract individual motifs for three-dimensional transformation; while digital media constructs virtual environments enabling users to adjust parameters in real-time and generate bespoke patterns.

Following multiple rounds of design iterations, a series of revitalisation proposals were developed, with representative outcomes selected for refinement. Upon review by relevant specialists, the revitalisation proposals received positive feedback across cultural heritage preservation and design innovation dimensions: the core motifs' distinctive characteristics were preserved, whilst the visual presentation demonstrated differentiated qualities compared to conventional products. Preliminary user research indicates that interactive customisation features exert a certain degree of influence on consumer interest, providing indicative evidence of the application potential for digital twin pathways [2].

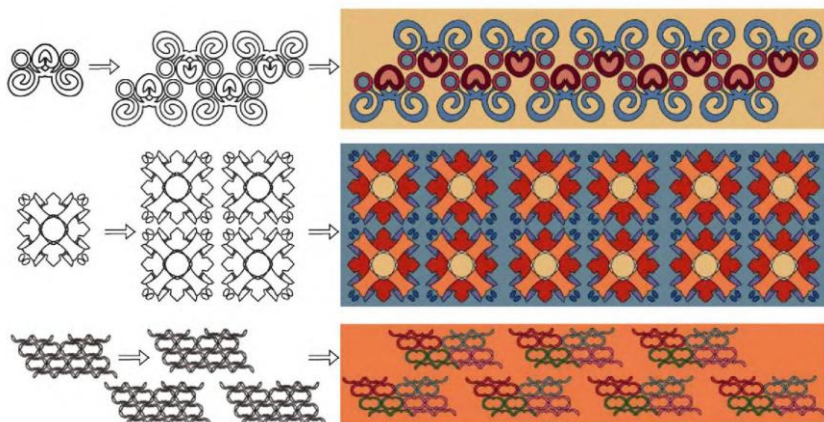


Fig.1. Miao Ethnic Costume Pattern Transformation Scheme [2]

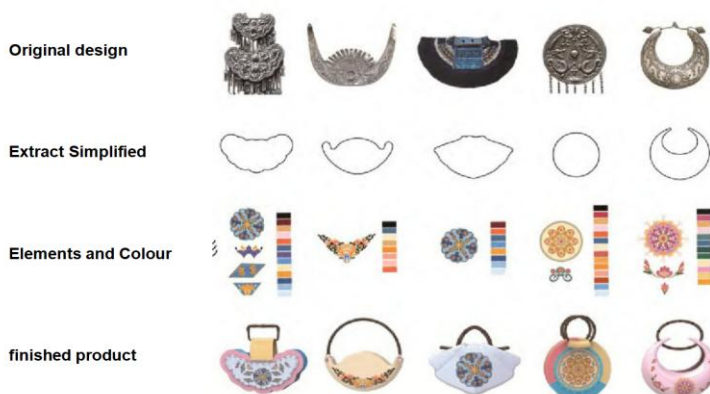


Fig.2. Cultural Souvenir Model Mapping. Research on the Transformation of Miao Ethnic Costume Elements through the Lens of Digital Twins, China, 2025 [2]



The findings demonstrate that digital twin technology not only facilitates the digital preservation of traditional textile artefacts but also, through parametric transformation, endows traditional patterns with “editable” and “evolving” properties. This approach provides a systematic design pathway from resource to product for the development of textile museum souvenirs (Fig.1, 2).

CONCLUSIONS

This study constructs a revitalisation design pathway for traditional textile patterns within the digital twin paradigm, achieving a paradigm shift from heritage preservation to design innovation through a three-step strategy. Findings demonstrate that digital twin technology not only resolves the dual challenges of dormant museum collections and homogenised souvenirs, but also establishes a dynamic equilibrium between cultural authenticity and contemporary aesthetics through parametric methods. This methodology provides a reusable technical framework for cultural and creative product development in textile museums, offering valuable reference for the creative transformation of traditional craft resources. Future research may further explore connectivity mechanisms for multi-source pattern databases, alongside the deep integration of AI-generated technologies with digital twins, thereby expanding the intelligent and personalised dimensions of museum cultural consumption [3].

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МА В.

ДИЗАЙН РЕВІТАЛІЗАЦІЇ ОРНАМЕНТІВ ДЛЯ СУВЕНІРІВ ТЕКСТИЛЬНИХ МУЗЕЇВ У КОНТЕКСТІ ЦИФРОВИХ ДВІЙНИКІВ

У статті досліджується методологія дизайну ревіталізації орнаментів у межах парадигми цифрових двійників для розв'язання таких проблем, як сильна гомогенізація сувенірної продукції текстильних музеїв та недостатнє використання ресурсів традиційних візерунків. Шляхом створення цифрових двійників традиційних мотивів та впровадження триетапної стратегії «екстракція-мапінг-регенерація», забезпечується перехід від статичного збереження до динамічного відродження культурних ресурсів. Це створює систематичний шлях для розробки культурних та креативних продуктів музеїв.

Ключові слова: цифровий двійник; текстильний музей; дизайн сувенірів; ревіталізація орнаменту; культурна трансляція.