

A Literature Review on the Application of Gourd Patterns in Modern Design

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Abstract:

This paper explores the path of transforming the gourd pattern from a traditional symbol to a modern design element, aiming to address issues such as insufficient theoretical depth, single carrier, and weak international expression in its application. Through literature analysis and case studies, combined with the cross-perspective of semiotics, folklore and design studies, this paper proposes a four-dimensional collaborative design approach of “decoding cultural genes, technology empowerment, user participation and global narrative”, and constructs a framework for the design transformation of the gourd pattern. The study verified the feasibility of parametric design, digital twin technology and cross-cultural brand collaboration for cultural embedding, and emphasized that the modern transformation of the gourd pattern needs to break through the limitation of “symbol transportation” and achieve cultural output that combines Eastern wisdom and universal values through technological innovation and global narrative. This paper provides theoretical support and practical paths for the modernization and innovation of traditional patterns to facilitate the global dissemination of Chinese culture.

Keywords:

Gourd Pattern, Modern Design, Cultural Genes, Parametric Design, Global Narratives

1. Introduction

As a core symbol of traditional Chinese auspicious culture, the gourd pattern carries multiple cultural connotations such as the worship of reproduction and the meaning of good fortune and prosperity. In recent years, under the impetus of the “cultural confidence” policy, its modern transformation has become the focus of academic research, but it still faces problems such as insufficient theoretical depth and a single carrier. This paper, through the cross-study of semiotics and design, constructs a collaborative framework of “culture - technology - design” for the gourd pattern, aiming to promote its transformation from “symbol transportation” to “deep cultural implantation” and facilitate the global dissemination of Chinese culture.

1.1. Research Background

The gourd pattern, as one of the core symbols of traditional Chinese auspicious culture, has a history dating back to the Neolithic Age. Over thousands of years of cultural accumulation, it has gradually evolved from a decoration of practical objects to an artistic language [1] carrying multiple symbolic meanings. In the primitive society, the gourd was given the symbolic meaning of reproductive worship because of its natural form and practical function; By the Ming and Qing dynasties, gourd patterns had become an important element of court art, incorporating auspicious themes such as happiness, prosperity and longevity, and permeating the fields of ceramics, fabrics and carvings. In recent years, with the promotion of “cultural confidence” and “revitalization of intangible cultural heritage” policies, the modern transformation of traditional patterns has become the focus of academic and design circles. However, current research is mostly focused on the historical description and cultural interpretation of the patterns, lacking a systematic exploration of the design transformation mechanism, and the practical application is limited to a few carriers such as cultural and creative products, failing to fully unleash the modern potential [2] of gourd patterns.

1.2. Research Objectives

This study, through literature integration and case analysis, systematically constructs the “traditional-modern” design transformation framework of the gourd pattern, and explains the contemporary adaptability of its cultural symbols; Extract the three-dimensional principles of “cultural gene inheritance - innovative design transformation - functional value symbiosis” and explore innovative application models across media and cultures; At the same time, it critically points out the deficiencies of existing research in the dimensions of user needs analysis, international symbol translation and technology integration, providing theoretical support and practical paths for the modernization innovation of traditional patterns.

1.3. Research Implications

This study, in response to the current limitation of gourd pattern research that emphasizes form over substance, has three practical implications: promoting the transformation of gourd patterns from static cultural relics to life-like symbols in the dimension of cultural inheritance and activating the contemporary vitality of traditional patterns; At the industrial innovation level, it provides actionable design strategies to verify the commercial value of traditional elements in the modern consumer market; From the perspective of international communication, through global visual translation, boost the gourd pattern to become an effective carrier for the export of Chinese culture, and jointly promote the modern transformation and multi-dimensional value-added [3] of traditional cultural resources.

2. The Historical Development and Cultural Connotations of the Gourd Pattern

2.1. Historical periods and cultural carriers

The gourd pattern, as an important symbol of traditional Chinese culture, has developed throughout Chinese civilization for thousands of years. In the painted pottery of the Banshan type of the Majiayao culture of the Neolithic Age, the gourd pattern combines the symmetrical distribution of the corset shape with the net pattern, and through the contrast of positive and negative shapes, it shows the primitive

people's understanding of the laws of nature, laying the foundation of its symbolic system. During the Sui and Tang Dynasties, the gourd pattern was endowed with auspicious meanings due to the homophonic meaning of "fortune and prosperity", and the Tang Sancai gourd vase achieved a secularization transformation of the pattern through three-dimensional forms and innovative glazes. Since the Song and Yuan dynasties, the gourd pattern has been deeply integrated with Taoist culture and folk beliefs. During the Ming and Qing Dynasties, it was more widely incorporated into clothing, architecture, and the decoration of objects, forming complex auspicious meanings such as "happiness and prosperity for all generations" and "continuation of descendants". Since modern times, the gourd pattern has broken through traditional carriers through cultural and creative design, digital media and other means, achieving a cross-era transformation from a religious symbol to a life aesthetic, and from a native symbol to an international language, continuously rejuvenating the vitality [4] of traditional Chinese decorative patterns.

2.2. Multi-dimensional Interpretation of Cultural Symbols

The gourd patterns carry the unique cultural genes and philosophical thoughts of Chinese civilization. Its cultural connotation is rooted in the worship of primitive reproduction and the symbol of the cosmic mother. The multi-seeded nature of the gourd was extended to represent the image of life continuation with "many descendants". Later, it was elevated by the Taoist philosophy of "heaven and earth in the pot", becoming a cosmic model that accommodates Yin and Yang and connects heaven and earth [5]. During the Tang and Song dynasties, the homophonic culture endowed it with the secular auspicious meaning of "having both happiness and honor". In the Ming and Qing dynasties, artisans combined the shapes of gourd vines entwined and fruits layered, giving rise to complex implications such as "eternal longevity" and "happiness and honor for all eternity". The expression techniques of positive and negative forms generating each other and the virtual and the real complementing each other in the decorative structure not only conform to the cosmology of "the unity of heaven and man", but also highlight the creative wisdom of "the coexistence of form and meaning". As a cultural symbol transcending time and space, the gourd pattern continuously conveys the eternal pursuit of the Chinese nation for the reproduction of life, the harmony of nature and a better life.

2.3. Analysis of the Artistic Characteristics of the gourd pattern

2.3.1. Composition form

The gourd pattern is a concentrated representation of traditional Chinese creative wisdom and aesthetic paradigms. The core structure often adopts axial symmetry and rotational symmetry, such as the circular distribution of four or six groups of girl-shaped gourds around the vessel in the half-mountain type painted pottery, which not only conforms to the curved surface characteristics of the pottery but also creates a balanced and stable visual rhythm. The composition of the pattern emphasizes the interplay of positive and negative forms, real and void, and intensifies the spatial hierarchy through the contrast between the gourd body and the background blank space, which is in line with the Taoist philosophy of the balance of Yin and Yang. The decorative technique follows the tradition of "line and color filling", with the outline outlined in black and red, and the interior filled with geometric units such as mesh and rhombic patterns, and the outer edge with zigzagged patterns to create rhythmic variations. This "combination of lines and surfaces, with a balance of

complexity and simplicity” approach developed into a three-dimensional expression [6] in the glaze blending of the Tang Dynasty three-color gourd vase. Particularly prominent is the combination of gourd patterns and other auspicious symbols, which, through the organic combination of vines entwining and fruit layering, not only retains the symbolic meaning of individual patterns but also forms a “perpetual” narrative of time and space, presenting the aesthetic logic and cultural code of “form and meaning interconstruction” of traditional Chinese patterns.

2.3.2. Language of color

The color language system of gourd patterns carries the profound symbolic connotations and aesthetic wisdom of traditional Chinese culture. From the black and red polychrome on the painted pottery of Majiayao in the Neolithic Age to the multicolored gilding on the court vessels of the Ming and Qing dynasties, the use of color has always followed the aesthetic principle of “form and color complement each other”. The early painted pottery created a strong visual contrast of black and red, with black Outlines outlining the full form of gourds and red filling patterns symbolizing the vigorous force of life. This primitive and pure color combination laid the foundation for the most authentic cultural genes [7] of the gourd pattern.

With the development of craftsmanship, the color language of the gourd pattern gradually became rich and formed a strict hierarchical standard. Folk art maintains the simple monochrome tradition, such as northern paper-cutting which conveys joy and auspiciousness in bright red, and southern blue and white printed cloth which shows freshness and elegance through the blank gourd pattern on the indigo background. Court art, on the other hand, developed a complex polychrome system: the Ming Dynasty’s doucai gourd pattern was outlined with blue and white, and the glaze was filled with vitriol, pale yellow, grass green and other colors to create a bright and magnificent visual effect; Enamelware of the Qing Dynasty introduced Western pigments and presented new shades such as pink and lake blue on the gourd patterns, but always maintained the royal dignity with gold outlining.

Contemporary designs have creatively transformed the colors of the gourd pattern. Parametric design techniques have enabled the application of modern colors such as gradient colors and fluorescent colors. For instance, a brand of smart speakers has adopted a gradient gourd pattern from emerald green to golden yellow, which retains the traditional meaning while embodying a sense of technology. The concept of sustainability has given rise to eco-friendly color schemes, such as indigo gourd-patterned fabric with plant dyes, which conveys ecological aesthetics [8] through low saturation tones. This blend of ancient and modern color practices not only perpetuates the cultural vitality of the gourd pattern but also promotes its new dimension of expression in the modern context.

3. Strategies for the Application of Gourd Patterns in Modern Design

3.1. Design Principles

3.1.1. Cultural principles

Retaining the core cultural implications of the gourd pattern is the foundation of design transformation, and it is necessary to avoid symbol hollowing out and meaning stripping. For instance, the Palace Museum’s “Fu Lu Xiang Xie” red envelope is

based on a Qing Dynasty gourd pouch, reinforcing the auspicious meaning of “Fu Lu Xiang Xie” through a ten-thousand-character pattern as the background, which not only continues the traditional meaning but also meets modern aesthetic demands. In the failed case, the “Cyber gourd” collectible toy was criticized as “cultural appropriation” for completely stripping away the details of the patterns and retaining only the outline symbols, which led to the fragmentation of the cultural image and highlighted the necessity [9] of decoding cultural genes.

3.1.2. The principle of innovation

Abstract reconstruction and cross-media transformation are the key paths to activating traditional patterns: Yu Yang from Qingdao University simplified the gourd pattern into a streamlined geometric pattern and adapted it to the Nordic minimalist home style through the golden ratio division, achieving a modern translation of traditional symbols; Feng Chunlei from Southwest University, based on the Dong gourd pattern and combined it with the rhombus pattern to create a dynamic interlaced visual language for dynamic digital screen design. In the field of parametric design, Grasshopper algorithms can generate infinite variations of gourd patterns. For example, the facade of a cultural center in Shenzhen presents a “virtual and real interplay” of light and shadow effect through parametric module splicing.

3.1.3. The principle of practicality

Functional adaptation and scene integration should run through the entire design process: The “Fulu Xiangyun” beach slippers enhance visual recognition with symmetrical gourd patterns. At the same time, they use EVA foam material and arch support structure, taking into account both decorative and ergonomic requirements. In terms of sustainable design, 3D printing technology combined with biodegradable PLA material for the gourd-patterned flower vase retains the beauty of traditional patterns while reducing the high energy consumption and carbon emissions [10] of ceramic firing. In addition, the application of gourd patterns in smart wearable devices, such as the Mi Band band, which uses laser etching technology to present miniature gourd patterns, achieves “lightweight cultural carrying”.

3.2. Design Method

The application of gourd patterns in modern design has formed a multimodal methodical system, with shape grammar as the core technical support. As a traditional Chinese auspicious pattern, the double spherical curve of the gourd pattern, which is smaller at the top and larger at the bottom, has been deconstructed into “growth logic” in modern design through shape grammar - designers break down the S-shaped outline of the gourd into golden ratio arc modules and achieve dynamic extension [11] through parametric algorithms. This grammar system retains the symbolic core of the gourd, which is “prosperity and longevity”, while giving it a new digital life: for example, the curved dome of Shanghai's Yuyuan metro station uses variant gourd pattern units that are continuously assembled to form a topological structure that has both traditional charm and futuristic feel; In the field of sustainable packaging, the organic form of the gourd is abstracted as an eco-module that can be nested, generating zero-waste cutting schemes through shape grammar. This algorithmic translation of traditional patterns not only continues the cultural genes but also creates a new paradigm that ADAPTS to modern production methods and aesthetic demands [12].

3.3. Application of Carriers

Shape grammar's translation of the gourd pattern makes it versatile in modern carriers: in architecture, the S-shaped curve of the gourd generates topological surfaces through parametric algorithms and is applied to nonlinear building skins; In product design, the golden ratio arc of the gourd is deconstructed into rotatable nested modules to form smart home components with mortise and tenon logic; In the field of digital media, the gourd pattern is interpreted as a dynamic light effect particle system through real-time generation algorithms; In the fashion field, Grasshopper tools are used to topologically transform the outline of a gourd to create bionic pleated structures that can be 3D printed. These carriers preserve the philosophical prototype of the "Yin and Yang mutual generation" of the gourd through shape grammar while endowing it with digital age traits such as topological deformation and parameter interaction.

4. Review of Current Research Status at Home and Abroad

Research at home and abroad in the field of modern translation of gourd patterns based on shape grammar shows differentiated paths: Domestic research focuses on parametric translation of cultural symbols. For instance, a team from Tsinghua University has developed a shape grammar system that can automatically generate 72 variations by establishing a vector database of gourd patterns and using the Rhinoceros+Grasshopper platform, with a focus on the adaptation of traditional patterns to parametric architecture; The team from Jiangnan University focused on digitizing intangible cultural heritage craftsmanship, breaking down gourd patterns into yin-yang arc modules and developing interactive design tools that can dynamically adjust the curvature. Research abroad is more focused on computational aesthetics innovation, such as the MIT Media Lab using machine learning to deconstruct the topological features of gourd patterns and training generative adversarial networks to produce industrial design prototypes with biological morphological features; Delft University of Technology in the Netherlands transformed the Fibonacci spiral of gourds into a sustainable packaging algorithm, achieving a 23% [13] increase in material utilization. The current research has three limitations: the cultural translation level is overly dependent on geometric deconstruction and neglects the contemporary translation of the meaning of "fu Lu"; At the technical integration level, parametric models have not yet formed an effective dialogue with traditional craftsmanship wisdom; The dynamic response and environmental interaction capabilities at the application innovation level need to be strengthened, which points out new directions for the development of cross-cultural algorithms and the integration of smart materials for subsequent research.

5. Research Deficiencies and Future Directions

5.1. Insufficient research

Current research still has multi-dimensional bottlenecks in the modern transformation of gourd patterns: First, the theoretical mechanisms and interdisciplinary research depth are insufficient. The existing achievements are mostly focused on the historical research and formal analysis of the patterns, and the systematic construction of the logic of design transformation is weak, especially in the cross-disciplinary fields such as semiotics and cognitive psychology, resulting in the fact that the mapping relationship of "pattern - function - emotion" has not yet formed

a quantifiable framework; Second, there is a structural imbalance in the application carriers. More than 68% of the practice is concentrated in cultural and creative products, while applications in fields such as architecture and interaction design account for less than 5%, and mostly remain at the surface decoration level, failing to organically integrate with spatial functions and user experience. Third, the absence of user research and market validation, with design strategies relying on subjective experience and lacking empirical data such as consumer cultural identity and aesthetic preferences, has led some “traditional + modern” graft-style designs to fall into market acceptance difficulties; Fourth, there is a cognitive gap in cross-cultural translation. The Western design community’s application of the gourd pattern is still confined to an Orientalist perspective, failing to reveal the philosophical core of its “way of life” through algorithmic translation, which hinders the in-depth development of cultural dialogue. These problems need to be addressed by building an interdisciplinary theoretical framework, expanding intelligent media carriers, establishing a user data-driven design system, and developing cultural semantic decoding algorithms [14].

5.2. Future Directions

Subsequent research requires in-depth exploration in three dimensions: First, develop a bidirectional mapping system of “cultural semantics - algorithm generation”, encode the philosophical core of the gourd pattern as adjustable parameters, and combine generative AI to construct an intelligent design tool with cultural explanatory power; Second, expand smart materials and dynamic interaction carriers, such as using 4D printing technology to achieve the temperature-sensitive deformation response of gourd patterns, or establishing a real-time feedback mechanism for user emotional data and dynamic pattern generation through brain-computer interface technology; Third, build a cross-cultural collaborative design platform that integrates global designers, intangible cultural heritage inheritors and user communities to achieve co-creation and sharing of digital assets of gourd patterns based on blockchain technology [15]. At the same time, a quantitative assessment system needs to be established to analyze users’ cognitive paths through eye-tracking, sentiment computing and other technologies, forming a closed-loop ecosystem of “data-driven - cultural translation - value co-creation”, ultimately promoting the paradigm upgrade of traditional patterns from cultural resources to the cornerstone of digital civilization.

6. Conclusions

This study systematically deconstructs the internal logic of the transformation of the gourd pattern from a traditional symbol to a modern design element by constructing a four-dimensional collaborative framework of “cultural gene decoding - technology empowerment - user participation - global narrative”. At the theoretical level, breaking through the binary opposition of “form - function” in traditional pattern studies, and through cross-validation of semiotics and parametric design, revealing the translation mechanism of the “symbiosis of form and meaning” cultural genes of the gourd pattern in the digital age. At the practical level, empirical cases of parametric algorithms, digital twin technology and cross-cultural brand collaboration have verified the adaptive innovation of traditional patterns in fields such as architecture, products and digital media. At the social value level, the gourd pattern has made an identity leap from a native auspicious symbol to a global cultural medium through emerging carriers such as NFT art and metaverse scenarios. Research has shown that

technology-enabled cultural translation can not only invigorate the contemporary vitality of traditional patterns, but also construct a visual language that combines Eastern wisdom and universal aesthetics, providing a replicable and innovative paradigm for the global dissemination of Chinese cultural symbols.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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