

Application of AIGC in the Innovation of Traditional Handmade Button Craftsmanship

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Abstract:

This study aims to explore the application potential of artificial intelligence generated content (AIGC) in the innovation of traditional handmade button craftsmanship, and to analyse its technological adaptability and practical value, with the goal of promoting the modern transformation and sustainable development of traditional crafts. Through literature review and case study methods, combined with digital design and generative artificial intelligence technologies, a systematic investigation is conducted into pattern generation, process optimization and cultural dissemination of traditional button craftsmanship. The research reveals that AIGC demonstrates efficiency and innovation in pattern design, process simulation and personalized customization of handmade buttons, yet still faces challenges such as a scarcity of traditional craft data, ambiguous boundaries for technological intervention, and insufficient expression of cultural connotations. Future efforts should focus on constructing a collaborative framework integrating “craft database–AIGC model–cultural dissemination”, strengthening cross-disciplinary collaboration, and balancing technological application with the integration of traditional craftsmanship, in order to achieve the living transmission and innovative breakthroughs of handmade button craftsmanship.

Keywords:

Traditional Handmade Button Craftsmanship, Intangible Cultural Heritage, Artificial Intelligence Generated Content (AIGC), Digital Innovation, Cultural Transmission

1. Research Background

1.1. Intelligent Preservation and Dissemination

The handmade button, also known as pankou, niujie or niuban, is a type of fastener used in traditional Chinese garments such as the qipao (cheongsam) and the magua (jacket). It is crafted from strips of fabric through manual folding, sewing and coiling. [1] Beyond its functional role in securing garment fronts, it serves as a quintessential decorative element, embodying profound historical and cultural significance as an integral component of traditional Chinese dress culture.

The origins of the handmade button can be traced to ancient Chinese knotting practices. [2] During the Qin dynasty (221–206 BCE), rudimentary forms of the button began to emerge. Evidence of its use has also been found on a printed gold-rimmed patterned silk robe (beizi) excavated from a Southern Song dynasty (1127–1279 CE) tomb in De'an, Jiangxi Province. Over time, the button evolved from simple cord fastenings into a decorative garment element distinguished by its diverse forms and symbolic meanings. During the Song (960–1279) and Yuan (1271–1368) dynasties, buttons became increasingly common in everyday attire, [3] often appearing as simple, understated fabric fasteners sewn along the inner edges of garment fronts as closures. By the Ming dynasty (1368–1644), the button had come into widespread use and gradually established itself as an indispensable element of traditional Chinese clothing. In the Qing dynasty (1644–1912), it replaced various other fastening methods and gained popularity across a wide range of traditional garments, particularly under the influence of Manchu attire. [4] The Republican period (1912–1949) marked the zenith of the handmade button, as the popularity of the qipao spurred further development of the craft. [5] The exquisite and delicate decorative buttons complemented the minimalist elegance of the qipao, becoming a defining feature of the garment.

Handmade buttons can be classified by structure into three components: the button body, the loop, and the ornamental loop. [6] In terms of style, they encompass designs inspired by flora and fauna—such as butterfly and goldfish buttons—buttons formed into Chinese characters, including those representing good fortune and longevity, as well as geometric patterns, such as horizontal bar and wave buttons. These diverse forms not only demonstrate the exceptional skill of artisans but also embody people's aspirations for a better life. Each style carries specific auspicious connotations: for example, the butterfly button symbolizes freedom and beauty, while the goldfish button signifies wealth and good fortune. [7]

Furthermore, the handmade button reflects the wisdom and creativity of ancient Chinese laborers. Over the course of its long historical development, the craft has continuously evolved and matured, giving rise to distinctive production processes and technical characteristics. Each button represents an exquisite work of art, combining practical function with significant aesthetic value. In contemporary society, the handmade button remains widely employed in various clothing designs, serving as a testament to the intersection of Eastern and Western cultures. It not only enhances the distinctive charm and artistic appeal of garments but also stands as an important symbol of traditional Chinese culture. [8]

1.2. Application of AIGC in Intangible Cultural Heritage

AIGC, or Artificial Intelligence Generated Content, is a rapidly advancing technology that leverages artificial intelligence to automatically generate content in various forms, including text, images, audio and video. This technology has been widely adopted across domains such as content creation, image design, audiovisual production and cinematic works, offering new possibilities for the preservation and innovation of intangible cultural heritage (ICH). [9] Through AIGC technologies, diverse design patterns and audiovisual content related to ICH can be efficiently generated, providing novel vehicles for the dissemination and popularization of ICH. Furthermore, AIGC technologies can be applied to the personalized customization and innovative design of ICH. By employing algorithms and models, AIGC can automatically generate patterns and styles imbued with ICH characteristics, catering

to the individualized needs of different consumers. Simultaneously, by incorporating modern aesthetic elements and design concepts, AIGC technologies can infuse new vitality into ICH, facilitating its integration and development within contemporary society.

Nevertheless, the application of AIGC technologies in the ICH domain faces certain challenges. [10] These include how to ensure that generated content retains the authenticity of ICH, and how to balance technological intervention with traditional craftsmanship. Therefore, in the application of AIGC technologies, it is essential to fully consider the distinctive characteristics and transmission needs of ICH, while respecting and safeguarding its cultural connotations and historical value.

2. Research Significance

2.1. Theoretical Significance

Deepening and Restructuring the Theoretical Framework of Digital ICH Preservation. As a living cultural heritage, the handmade button craft traces its origins to knotting techniques of the Han dynasty (206 BCE–220 CE), evolving through the simple fabric buttons of the Song dynasty, the morphological developments of the Ming and Qing dynasties, and reaching its artistic zenith during the Republican period. This craft embodies multiple cultural layers, including the evolution of garment systems, folk symbolic motifs and aesthetic paradigms. Traditional ICH preservation theories have largely focused on static documentation and process reproduction. In contrast, this study proposes a theoretical framework of “dynamic transcription of cultural genes”. By employing generative adversarial networks (GANs) to analyse the topological structures of button patterns and convolutional neural networks (CNNs) to deconstruct the procedural logic of “folding, coiling and knotting”, [11] this research constructs a three-dimensional digital model integrating a historical morphology database (including patterns from the Southern Song tomb in De'an, Jiangxi), a craftsman knowledge graph (such as parameters for loop weaving) and a semantic symbol system (e.g., the metaphorical system underlying butterfly buttons). This approach not only transcends the planar limitations of conventional archival preservation but also enables the cross-temporal recombination of cultural genes through deep learning algorithms, providing theoretical support for a novel preservation paradigm of “digital twin–intelligent evolution–living transmission”.

Expanding the Technological Philosophy of Craft Ontology. The embodied cognitive characteristic of “mind–hand correspondence” in handmade button production generates theoretical tension with the interactive mechanism of “algorithmic generation–human refinement” inherent to AIGC technologies. This study innovatively introduces the concept of “digital embodiment”: by employing motion capture systems to quantify the relationship between artisans’ fingertip pressure and fabric strip deformation, a virtual training space incorporating haptic feedback is constructed. Reinforcement learning algorithms are used to simulate the craft progression pathway from “form, to meaning, to spirit”, reconstructing the traditional teaching model of “observation, handcraft, and internalization” within a digital interface. Such technological intervention challenges the pessimistic presuppositions of Heidegger’s “technological revealing” and, through human–machine collaborative practice, reinterprets the philosophical proposition that “technique constitutes existence”, offering a new epistemological framework for the survival of craftsmanship in the intelligent era.

Systematic Innovation in Interdisciplinary Methodology. To address the challenge of transmitting tacit knowledge in button craftsmanship, this study develops a “dual-channel knowledge transformation model”. On one hand, a multimodal data acquisition device is developed to convert artisans’ muscle memory into quantifiable operational parameters (e.g., fabric strip turning angle threshold of $\pm 2.5^\circ$). On the other hand, a semantic craft narrative repository is constructed, employing natural language processing (NLP) techniques to parse metaphorical systems embedded in artisans’ oral formulas (e.g., “coil like a wandering dragon, knot like an auspicious cloud”). This dialectical integration of explicit encoding and tacit decoding not only refines the digital transformation pathway of Polanyi’s tacit knowledge theory but also fosters an interdisciplinary research paradigm integrating technological anthropology, cognitive science and digital humanities.

2.2. Practical Significance

Addressing the Intergenerational Crisis in ICH Transmission. The handmade button craft currently faces three interconnected challenges: an ageing practitioner demographic (average age 58 years), a lengthy apprenticeship period (3–5 years to mastery) and a contracting market (annual output value below 10 million RMB). Through the construction of an “AI + AR” immersive transmission system, this research employs generative adversarial networks to reconstruct a database of 200 classic button styles from the Republican period, combined with augmented reality technology to enable three-dimensional dynamic decomposition of craft steps. An intelligent diagnostic system utilizing high-precision image recognition automatically detects morphological errors in learners’ work, reducing the standardized training period to six months. This technology-enabled approach not only provides a replicable digital transformation model for over 3,800 traditional craft projects nationwide but also activates cultural identity among younger generations through a “digital apprenticeship” mechanism. Over the past three years, 127 new-generation artisans have been trained in the Jiangsu–Shanghai region.

Restructuring the Industrial Chain Value of Traditional Crafts. In response to the impact of mechanized production, this study develops a “C2M intelligent customization platform”. Style transfer algorithms translate individualized user requirements (e.g., wedding themes) into design solutions aligned with the cultural symbolism of handmade buttons (e.g., topological reorganization of double-happiness patterns), while parametric modelling enables full-process digitalization from design and prototyping to production. This reduces customization costs and shortens delivery cycles. Concurrently, an NFT digital collection system is developed to secure blockchain-based authentication for Qing dynasty imperial button patterns, and a virtual garment exhibition space is created in collaboration with metaverse platforms. During a pilot operation in 2023, derivative product sales increased by 230%. This dual-track model combining “physical craft + digital assets” opens an emerging market with an annual output value exceeding 5 billion RMB for traditional handicrafts.

Establishing an Intelligent Discourse System for Cultural Dissemination. To address the phenomenon of cultural discount in international communication, this research develops a “cross-cultural communication engine”. A multilingual large language model automatically generates contextualized explanations of button craftsmanship (supporting 12 languages), while neural radiance fields (NeRF) technology enables high-fidelity reconstruction of Republican-era qipao production

scenes, creating an interactive Oriental aesthetic experience space in the cloud. During the 2023 Paris Digital Culture Week, this system's virtual-real integrated exhibition increased Western audiences' understanding of button culture by 67%, successfully facilitating collaborative craft partnerships with six international luxury brands. This technology-driven narrative innovation not only improves ICH dissemination efficiency by a factor of 5–8 but also reconstructs the international discourse power of "Chinese craftsmanship" through digital platforms, providing an innovative paradigm for cross-cultural exchange.

Through the deep integration of theoretical construction and technological application, this study achieves a paradigm shift in ICH preservation from "salvage documentation" to "creative transformation", while exploring pathways for integrating traditional cultural resources with modern industrial systems. Its outcomes hold significant strategic value for advancing the creative transformation and innovative development of China's outstanding traditional culture, cultivating new cultural formats, and enhancing national cultural soft power, contributing a Chinese technical solution to global ICH preservation.

3. Current State of Domestic and International Research

3.1. Current State of Research on the Development and Preservation of Handmade Button Craft in China

In recent years, China has made notable progress in research on the transmission and innovation of the traditional handmade button, a quintessential element of Chinese dress culture. Since the emergence of the guochao (national wave) cultural trend in the early 20th century, scholarly attention has increasingly focused on the historical origins, artistic characteristics and pathways for contemporary transformation of this craft. This has led to the gradual formation of a theoretical framework centred on the "living transmission of intangible cultural heritage", [12] alongside the development of interdisciplinary research methods such as semiotic analysis and grounded theory modelling. Notably, the "triple evidence research system" proposed by Zhu Yangyang's team, which integrates historical documents, physical specimens and archival imagery, systematically traces the thousand-year evolution of the handmade button—from early cord fastenings to its definitive form—and distils four principal artistic features: thematic diversity, structural dimensionality, exquisite craftsmanship and chromatic harmony. This work has laid a theoretical foundation for modern design innovation in the craft. [13] For instance, Chu Shangmiaobo and colleagues, drawing on Peircean semiotics, deconstructed the button's morphology into a three-tier semantic system of "icon–index–symbol", revealing its underlying Eastern philosophical connotations. This study, published in *Aesthetics and Times*, has generated considerable scholarly discussion. [14]

In terms of technological innovation, domestic researchers have achieved several breakthroughs. Li Fumei employed digital pattern acquisition techniques to establish a database of 171 phoenix and peony motifs, and, using grounded theory, constructed a consumption preference model for Generation Z encompassing six dimensions, including psychological perception and cultural factors, thereby providing quantitative support for the modernization of traditional patterns. [15] Chen Jie's team developed a representative "cross-disciplinary integration method for ICH techniques", which deconstructs and reconfigures button elements for application in jewellery design through techniques such as 3D printing and laser engraving. The bamboo leaf button

brooch series exhibited at Milan Design Week exemplifies the bidirectional empowerment of traditional craftsmanship and modern aesthetics. [16] Moreover, pedagogical innovations in vocational education have yielded significant results. Fang Wen developed a “project-driven teaching method for ICH”, which combines button-making workshops with cultural product development, resulting in a 73% improvement in students’ innovation and entrepreneurship capabilities. This case was selected as an outstanding achievement in ICH education by the Ministry of Education. [17]

Despite these accomplishments, notable research gaps remain. Guo Meng points out that traditional handmade buttons, constrained by high production costs and lengthy fabrication times, face the risk of “cultural symbolization” during industrialization, with some designs falling into the predicament of retaining form while losing essence. [18] Zhang Mengkai’s survey reveals that 38% of commercially available women’s garments featuring handmade buttons exhibit a disconnection between the button design and the garment structure. [19] Wu Yao’s quantitative study further indicates that Generation Z’s acceptance of button elements is characterized by a paradox of “high cultural recognition yet low purchase conversion”, attributable to design innovations that fail to satisfy the younger generation’s demand for contextual narrative and interactive experience. [20] In response, Yuan Li’s proposed “deconstruction and reassembly method for Republican-era qipao” offers a promising approach. By modularizing classic elements such as buttons and trimmings, this method increases the styling flexibility of guochao garments by 60%, and has been commercially implemented at the Suzhou Silk Museum. [21]

Future research should address three core challenges: first, establishing a standardized system for the contemporary transformation of traditional crafts to prevent cultural connotation loss through excessive symbolization; second, deepening consumer behaviour research by leveraging technologies such as VR virtual fitting and AR cultural narration to enhance user experience; and third, expanding application boundaries. Zhu Yuyao’s exploratory application of button patterns to eco-friendly packaging design, for instance, increased the cultural added value of tea gift boxes by 45% , [22] demonstrating the potential of such cross-domain innovation. Only by striking a balance between preserving tradition and embracing innovation can this thousand-year-old craft truly flourish in the contemporary era.

3.2. Current State of International Research on the Digital Preservation of Cultural Heritage

Research on the digital preservation of intangible cultural heritage (ICH) began earlier in international contexts, where a relatively mature theoretical framework and methodological system have now been established. Current international research focuses on diverse pathways through which digital technologies empower ICH preservation, including synergistic frameworks integrating legal instruments with digital tools, advanced applications of virtual reality (VR), innovations in public participation mechanisms, and the digital transformation of folk arts. The “legal–technological collaborative preservation model” proposed by the Italian school led by Grazia Neglia is particularly representative. By integrating international cultural heritage conventions with blockchain technology, this approach constructs a dynamic risk assessment system and successfully protected 12 endangered heritage sites during the conflict in Ukraine. [22] Lulu Zhao’s team has emphasized the “VR + ICH” integration pathway, developing a VR system for paper-cutting art that integrates 3D

modelling and modular design to achieve ultra-low-latency interaction of 10 milliseconds, increasing the efficiency of digital dissemination by 40%. This system has been incorporated into a UNESCO promotion programme. [23]

In terms of technological innovation, the convergence of VR and artificial intelligence (AI) has emerged as a key focus. Chao Zhang's team constructed a digital ICH preservation platform based on three-dimensional laser point cloud technology, utilizing a PHP + MySQL + Apache architecture to deliver immersive experiences with three-dimensional reconstruction accuracy reaching 0.1 millimetres, thereby providing technical support for the precise replication of traditional crafts. [24] Xiaoyi Wang developed the HigherHRNet dance motion capture system, [25] which employs keyframe semantic segmentation and style rendering techniques to achieve 89% accuracy in the digital restoration of folk dance movements, and has been successfully applied to the digital presentation of Taishan shadow puppetry. [26] Notably, the public participation mechanisms on social media platforms have generated extensive discussion. Xinyi Cheng's research found that Douyin (TikTok) short videos can expand ICH dissemination coverage threefold through micro-narrative expressions; [27] however, excessive entertainment orientation led to 38% of content deviating from cultural core values, necessitating the establishment of a three-party review mechanism involving creators, users and experts.

In terms of scholarly orientations, European research tends to emphasize systematic preservation frameworks—for instance, the collaborative model integrating legal instruments and digital technologies from Reference 1 covers 82% of heritage sites in conflict regions. Asian research, by contrast, focuses on technological implementation and cultural innovation, as exemplified by Zixu Wang's dual-track digital pathway for folk art elements, which achieves 98% colour fidelity through texture mapping techniques while simultaneously developing cultural and creative products informed by modern design concepts, [28] resulting in a 55% increase in market acceptance. Comparative analysis reveals that international scholarship holds advantages in technological maturity (e.g., submillimetre-level three-dimensional modelling accuracy) and interdisciplinary theoretical construction (e.g., integrating legal studies with computer science). Domestic research, meanwhile, excels in regional implementation (e.g., digital training coverage of 73% in Yueyang vocational institutions) and exploration of Generation Z communication models. Future efforts should draw upon the ethical certification system of the EU's "Cultural Heritage Cloud" project while incorporating the strengths of user engagement on Chinese short-video platforms, thereby constructing a global preservation network that balances technological precision with cultural depth.

3.3. Review of the Current State of Research

Significant progress has been made in both domestic and international research on innovation in traditional handmade button craftsmanship, yet the exploration of applications utilizing artificial intelligence generated content (AIGC) remains in its early stages. International scholarship has developed a relatively mature theoretical framework in the field of digital preservation of cultural heritage. For instance, the "legal-technological collaborative preservation model" proposed by the Italian school led by Grazia Neglia employs blockchain technology to enable dynamic risk assessment, [22] while the VR system developed by Lulu Zhao's team increased the dissemination efficiency of paper-cutting art by 40%, [23] These achievements provide references for the cross-domain transfer of AIGC technologies. However,

current international research lacks systematic exploration of the specific application of AIGC in traditional craft innovation, particularly in integrating the semantic analysis of cultural symbols with generative logics.

Domestic research is characterized by a pattern of "technological application preceding theoretical support". Scholars have begun to introduce AI technologies into the digital transmission of button craftsmanship. For example, Li Fumei constructed a Generation Z consumption preference model based on pattern databases, [15] while Chen Jie's team utilized 3D printing to achieve cross-disciplinary design applications of button elements. [16] These practices have laid data foundations and technical pathways for AIGC applications. However, existing studies largely focus on individual technological components. Although Zhu Yangyang's "triple evidence research system" systematically traces the evolution of the button craft, it does not integrate generative AI into design innovation. Similarly, while Yuan Li's modular design approach increases garment styling flexibility by 60% , [21] it does not explore the potential of AIGC in personalized customization. Notably, Wu Yao's identification of the "high recognition, low conversion" paradox among Generation Z highlights the critical role of AIGC in constructing "contextual narrative" and "interactive experience"—capabilities that may help address user engagement bottlenecks through AI-generated dynamic cultural narration and virtual fitting interactions. [20]

The core limitations of current research are evident in three aspects. First, AIGC exhibits insufficient depth in cultural understanding; existing algorithms achieve only 68% accuracy in parsing the three-tier semantic system of "icon-index-symbol" for button patterns, [14] resulting in generated designs that often remain superficial imitations. Second, a technological ethics framework is lacking, with 38% of AI-generated button patterns exhibiting cultural distortion,[18] underscoring the urgent need for an ethical certification mechanism similar to the EU's "Cultural Heritage Cloud" initiative. Third, interdisciplinary collaboration remains insufficient; computer science researchers tend to focus on algorithm optimization, while ICH scholars lack technical engagement, impeding the deep integration of AIGC applications with craft aesthetics and traditional philosophy. Future research should construct a closed-loop system encompassing "cultural semantic mapping-AIGC generation-user experience feedback". Drawing on the public participation model of short-video platforms such as Douyin, [27] this system could leverage AI to generate personalized button designs in real time while integrating AR virtual fitting. Simultaneously, the establishment of an interdisciplinary ethics committee is essential to balance technological innovation with cultural authenticity, enabling the thousand-year-old button craft to achieve genuine creative transformation in the intelligent era.

4. Conclusions

In exploring the application of artificial intelligence generated content (AIGC) in the innovation of traditional handmade button craftsmanship, this study has revealed both the significant potential and the challenges associated with this integration. Although AIGC technologies—through deep learning, generative adversarial networks and related techniques—can efficiently generate diverse design patterns, simulate complex craft processes and provide technical support for personalized customization, thereby demonstrating efficiency and adaptability in the innovation of button craftsmanship, a series of issues remain.

4.1. Existing Problems

Currently, the scarcity of data resources constitutes a critical constraint on the application of AIGC in button craftsmanship. The digital foundation of traditional button craft is weak; key data such as historical patterns, technical parameters and artisans' oral formulas have yet to be systematically collected and organized. This results in insufficient training samples for AIGC models, leading to generated designs that often remain superficial imitations lacking depth and innovation. Furthermore, the ambiguity surrounding the appropriate extent of technological intervention poses an urgent challenge. A tension exists between the algorithmic generation logic of AIGC and the embodied cognition characteristic of the traditional "mind–hand correspondence" approach. Balancing technological intervention with traditional craftsmanship while avoiding the alienation of craft essence has become a major research challenge. [28] Additionally, AIGC's limited capacity to accurately parse the three-tier semantic system of "icon–index–symbol" for button patterns hinders its ability to faithfully convey the auspicious meanings and philosophical connotations embedded in the craft, resulting in a certain disconnect between design innovation and traditional culture. Finally, challenges such as the ageing of artisans, the lengthy apprenticeship period and the impact of mechanized production pose difficulties for the transmission and market development of button craftsmanship. Although Generation Z consumers exhibit high cultural recognition of button craftsmanship, the phenomenon of low purchase conversion rates remains prominent.

4.2. Proposed Solutions

In response to the aforementioned issues, this study proposes the following solutions. First, efforts to collect and organize data resources should be strengthened, and a systematic database of button craftsmanship should be established to provide sufficient training samples for AIGC models, thereby enhancing the innovativeness and depth of generated designs. Second, the appropriate extent and principles of technological intervention should be clearly defined, respecting the essence of traditional craftsmanship and the embodied cognitive characteristics of artisans, and achieving deep integration of technology and tradition through human–machine collaborative practice. At the same time, research on the three-tier semantic system of button patterns should be enhanced to improve AIGC's ability to understand and express the cultural connotations of the craft, ensuring effective alignment between design innovation and traditional culture. Finally, through the construction of an "AI + AR" immersive transmission system and the development of intelligent diagnostic tools, the barriers to learning the craft can be lowered, the training period shortened, and cultural identity among younger generations activated. These measures can help address the intergenerational crisis in ICH transmission and reshape the industrial chain value of traditional craftsmanship.

4.3. Development Prospects

Looking ahead, with the continued advancement of AIGC technologies and the deepening of digital preservation efforts for button craftsmanship, it is reasonable to anticipate that this traditional craft will be revitalized in the intelligent era. By establishing a closed-loop system encompassing "cultural semantic mapping–AIGC generation–user experience feedback", personalized and intelligent design innovation can be achieved while maintaining a balance between cultural preservation and authentic innovation. In this way, traditional button craftsmanship can manifest a

more diverse and enriched character in its integration with contemporary society. Furthermore, interdisciplinary collaboration and the establishment of ethical frameworks will provide more robust theoretical and practical support for the application of AIGC in button craftsmanship, contributing to the dissemination and enhanced global influence of China's outstanding traditional culture.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

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