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Research on the Regeneration Design of Intangible Cultural Heritage Pattern and Cultural Symbols Enabled by AI—Generation and Innovative Application of Paper Cutting in Ansai as an Example

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Abstract. Purpose To analyze the pattern characteristics of Ansai paper-cutting through Derrida's structuralist analysis, providing more insights and references for the interpretation and research of Ansai paper-cutting patterns from a semiotic perspective. From the perspective of Derrida's deconstruction, critically analyze the binary opposition structure in Ansai Paper Cuttings. Using Derrida's structuralist concepts such as binary opposition, structural recombination, and linguistics, the study interprets the deeper relationships within the patterns of Ansai paper-cutting. Modern design techniques are employed, and AI technology is used to input the required text content, converting it into the designated AI software. Innovations and breakthroughs are made in pattern generation, style transfer, and structural recombination, with cultural and creative products serving as the medium for design transformation. Conclusion The patterns of Ansai paper-cutting exhibit distinct artistic features, regional characteristics, and unique aesthetics. By applying AI technology to extract and derive the semiotic elements of its craftsmanship, patterns, and colors, this study explores various possibilities for the design transformation and innovative application of Ansai paper-cutting patterns. This not only revitalizes intangible cultural heritage by integrating modern technology but also aids in the inheritance and development of Ansai paper-cutting patterns.

Keywords: Ansai paper cutting, AI technology extraction, structural recombination, cultural and creative product design

1. Introduction

1.1. Research background

Anse paper-cutting, a folk art created by the vast number of working women on the Loess Plateau in northern Shaanxi, is one of the key representatives of the region's folk culture. In 1993, Anse County was designated as the' Chinese Paper-cutting Hometown 'by China's Ministry of Culture. On August 19,2010, UNESCO announced that Anse paper-cutting had been included in the Representative List

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of the Intangible Cultural Heritage of Humanity. However, with the intensification of globalization and the acceleration of modernization, ICH faces declining public awareness , leading to a crisis in the inheritance of Anse paper-cutting. A 2024 survey revealed that there are only 12 national-level inheritors, with an average age of around 68 years old [1]. The issue of generational gaps in inheritance and innovative development of Anse paper-cutting is worth considering.

1.2. Development and application of AI technology

The essence of AI represents new productive forces [2], representing a new mode of innovation and an essential tool for future design and application. As a representative of China's outstanding intangible cultural heritage, Ansai paper-cutting leverages AI technology to enhance the dissemination and expression of excellent culture. By using AI, it fosters value and emotional resonance among people, thereby promoting the spread and development of China's excellent traditional culture.

As the culture of technology continues to flourish, a variety of generative AI painting products have emerged. Currently, the most popular applications include Midjourner, DALLE, Tencent Mix, and Yimeng. AI technology is increasingly integrated into our daily lives, with more people using AI to assist in their creative processes. By simply entering your desired content in a text box, AI can generate the desired results. The advent of this AI technology has greatly enriched our creative design ideas for the future.

2. Decoding the cultural genes of Ansai paper cutting

2.1. Symbolic characteristics of paper-cut patterns in Ansai

Lotman and Tartu--Semiotics of Leningrad before the birth of cultural semiotics in 1973 [3]. The text explains that semiotics encompasses language, text, structure, models, and modeling systems. The advent of AI technology has significantly reduces creative labor costs. Creators can use existing language, texts, and cultural symbols from the region to pre-draw the visual patterns for their ideas using AI technology. This construction of symbolic language allows people to perceive the ideological culture, emotional values, and aesthetic characteristics of the Yan 'an region, making it one of the representative symbols of Yan' an.

2.2. Symbol system characteristics of Ansai paper cutting

According to the Peirce semiotics theory [4], the cultural symbol system of Ansai paper-cutting can be divided into three structural levels. The signifier level: These are directly perceptible and immediately usable in the pattern, such as the sawtooth pattern (sharp like teeth, expressing ruggedness and boldness), the crescent moon pattern (directly imitating the shape of the moon, like the gentle and cold moonlight), and the petal pattern (often created in the form of plum blossoms, typically combining flowers with money to express wealth). The signified level: These are the specific real things or concepts represented by the symbols (see Figure 1 for details). The interpretative element: The emotional transmission conveyed by the patterns not only requires direct visual communication but also relies on the context — specific cultural settings. For example, the wedding-themed 'Lotus Child' can only appear in a wedding setting; appearing in other settings would not align with the theme of paper-cutting.

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Table 1. The core cultural symbol system of — Ansai paper cutting

type	usage scenario	Representative pattern	key	semanteme
The Child with the Hairpin	Chinese Spring Festival	A human head with two buns or the shape of a bird		Bless yourself with health and safety
Snake in the Jar	Home decoration, wedding decoration	The snake rabbit fusion is mostly a spiral structure		May the family be happy and well. Best wishes for the wedding
The Bowl That Clanged	Wedding arrangements	The shape of two bowls joined together		The couple is in love and harmony
The Birth of a Gourd	Daily decor	The shape of the gourd and its surrounding the baby		Expecting pregnancy

3. The path of pattern generation technology driven by AI

3.1. Data collection and preprocessing of paper-cutting culture

As a cultural symbol of the Yan'an region, Ansai paper-cutting still faces challenges such as insufficient inheritance and innovation. Despite its rich cultural resources and historical significance, it struggles to overcome these current difficulties. Based on the existing handicraft techniques and cultural resources, we should first categorize the themes of paper-cut patterns. When collecting data, we should use at least 500 works from basic databases and continuously update with new creations. According to Eco's concept of 'contextual circle' [5, 6], we should view art works as symbolic structures, giving them specific directions and vivid imagery, and strengthening their connection with the external environment. Therefore, in cultural design practices, we should integrate external elements such as architecture (like the Yellow River and Hukou Waterfall), food, and other crafts. For example, Shanxi intangible cultural heritage bearers have used 'Black Myth: Wukong' to launch mooncakes featuring ancient Taiyuan city and other buildings, catering to young people and innovating flavors.

3.2. Construction and design practice of paper-cutting design path

To facilitate the design of cultural and creative products using AI technology, we need to consider how to effectively integrate Ansai paper-cutting with generative tools to achieve the desired results. For the creation of Ansai paper-cutting cultural and creative products, we should conduct practical research by integrating local culture, using AI-generated examples as references to lay the foundation for proposing principles for the integration of Ansai paper-cutting cultural and creative products with AI, thus establishing a complete path, as shown in Figure 1.

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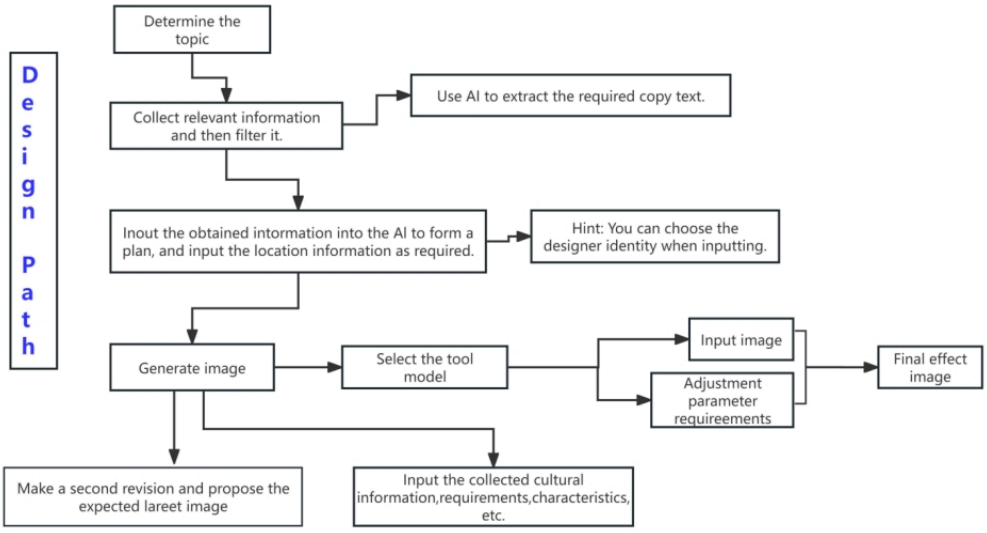

Figure 1. Process diagram of AI-generated cultural and creative products

Comprehensive preliminary research mitigates risks of AI hallucination through large-scale research in the early stage, it can effectively avoid problems such as artificial facts created by AI tools and ensure that the generated images meet the expected purpose.

4. Analysis of key points of AI technology enabling local cultural and creative product design

4.1. Accurately grasp the direction of generated content

The core value of local cultural and creative products lies in expressing the unique cultural characteristics of the region. This requires us to focus on the most essential cultural features during the research process. To ensure the accuracy of AI-generated images, we should provide clear and specific descriptions, avoiding abstract expressions, and can use line drawings or patterns as auxiliary tools for generation. A comprehensive exploration of Ansai paper-cutting culture is the foundation of the design, covering aspects such as artistic expression, folk culture, and introductions to heritage bearers, using a multi-element approach. The selected cultural elements should be representative, unique, and characteristic of the region, highlighting the essence of the culture. It is important to strike a balance between inheritance and innovation while closely aligning with market demands. To enhance the accuracy, feasibility, and respect for the extraction of intangible cultural heritage patterns, the final generated patterns must be reviewed by paper-cutting heritage bearers, and the generated patterns must achieve a 90% approval rate.

4.2. Translation and application scenarios of cultural and creative products

The integration of AI technology has provided us with new design ideas and enhanced the application effects and scene expressions. By intelligently generating symbols and patterns, it boosts the creativity of cultural and creative products, highlighting personalization and innovation. Using AI technology, local cultural elements can be re-created and reconstructed, resulting in unique and appealing images, texts, and videos. These methods create a blend of virtual and real cultural experience spaces, such as VR experience halls and AR animations, which attract more young people and allow them to deeply appreciate the charm of Ansai paper-cutting culture.

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4.3. Technical disputes and sustainable development

Although AI technology provides us with faster and more efficient design ideas, Online data exhibits significant heterogeneity, and there is no sufficient technical support for it to automatically screen out accurate and reliable information. In the use of AI, problems such as symbol alienation, incorrect pattern and copyright disputes are easy to occur.

In view of the problems, we should establish a relevant guarantee system, mark "AI generated" in the use of pictures, and establish an intellectual property mechanism related to intangible cultural heritage, so as to protect the works of intangible cultural heritage inheritors from damage.

5. Conclusion

Although the inheritance and development of Ansai paper-cutting still face challenges and difficulties, Research indicates, as inheritor Liu Jieqiong said, "Hinged flowers are a cultural gene—flowing in our blood, waiting to be awakened by the times." As a 'digital apprentice,' AI can only activate the eternal vitality of intangible cultural heritage (ICH) by respecting its cultural essence. In future development, AI will continue to improve and evolve, becoming a primary tool. It not only brings new design ideas but also promotes the spread and exchange of local culture, while offering new opportunities and development for ICH in various regions. However, the emergence of AI has significantly diminished the handmade value of ICH cultural products. How to balance the relationship between AI and traditional craftsmanship in the future is a question we need to further consider.

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