

# *Research and Implementation of Innovative Design of Paper Cuttings Pattern Based on Artificial Intelligence Technology*

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**Abstract:** This research focuses on the application of artificial intelligence technology in the field of traditional culture and art, especially in the revitalization and innovation of traditional Paper Cuttings pattern design. By integrating AI technologies such as computer vision, deep learning and generation of confrontation networks, this paper proposes a new methodology for Paper Cuttings pattern design. This methodology not only emphasizes the potential of AI in improving design efficiency and creativity, but also focuses on how to maintain and inherit the cultural value of Paper Cuttings art. Through in-depth analysis of the geometric characteristics and cultural symbols of Paper Cuttings art, the research realized the innovation of automated Paper Cuttings design. This study demonstrates the new application of AI technology in artistic creation, providing a new technological path for the modern transformation of traditional art, and also opening up directions for future research in the field of artificial intelligence and cultural and artistic integration.

## 1. Introduction

With the rapid development of artificial intelligence technology, its application in various fields is increasingly extensive, especially in cultural and artistic creation, AI technology has begun to play an important role. Design the way of interaction between people in virtual space. In the era of artificial intelligence, that is, the era in which we live now: artists use artificial intelligence machines to learn related technologies to create art and express their ideas and concepts; Designers use neural network model to train and create their own design tools and assistants, instead of some tedious and boring work. People only need to do those parts that need creativity, imagination and emotion most, and leave the rest to artificial intelligence [1-2]. So today, with the assistance of artificial intelligence technology, art and design become simpler, and more people can enjoy the happiness brought by art and design. With the help of artificial intelligence technology, we can finish the work that only professionally trained artists or designers can do in a short time, and everything becomes interesting. People use smart applications in mobile phones to transfer the style of photos taken in their lives, generate artistic images, or shoot and edit short videos, and use their virtual circle of friends as a display space. We are creating art and recording life almost every day;

If you want to design posters and trademarks, you can also get a satisfactory and applicable design scheme directly on your smart phone through simple operations [3]. Paper-cutting is an ancient traditional folk art in China. It has a long history and unique style. It is deeply loved by people at home and abroad. Relying on the designer's rich imagination and high generalization power, it grasps the most moving and expressive image in reality, cuts out the internal pattern lines by the method of combining reality with reality, reflects the beauty of the pattern by comparing money with space, and creates a decorative artistic image by using exaggerated and deformed methods, concise lines and bright colors in modeling design. With the development of society, paper-cutting has developed into a folk craft, from pure manual operation in the past to mass production and commercialization now[4]. The purpose of this study is to explore how to use artificial intelligence technology to inject new creativity and vitality into paper-cut pattern design, so as to realize cultural inheritance and artistic innovation. First of all, this study expounds the application status of artificial intelligence in the field of design and its potential in artistic creation, especially the possibility of simulating and enhancing human creativity. Then, it discusses the historical and cultural significance of traditional paper-cutting art, as well as the challenges and bottlenecks it faces at present [5]. Through comprehensive analysis, this paper puts forward a theoretical framework of innovative design of paper-cut patterns based on AI, and describes in detail the specific methods and steps to realize this framework. By integrating computer vision and machine learning technology, the application of AI in paper-cut pattern recognition and generation is explored. Secondly, establish a paper-cut pattern innovation system combining traditional paper-cut elements with modern design concepts; Finally, the practical application value of the system in cultural and artistic creation is evaluated [6]. In addition, this study will also focus on the contribution of AI technology in improving the innovation, personalized customization and cultural value inheritance of paper-cut design. Through this study, it is expected to provide a new perspective and technical support for the modern transformation of traditional culture and art. The ultimate goal of this study is to open up a new way of paper-cut art innovation through the cross-integration of science and technology and art, and at the same time provide reference for the innovation of other traditional art forms.

## **2. Application of Artificial Intelligence Technology in Paper Cuttings Design**

### **2.1. Design Theory of Artificial Intelligence Technology**

In the history of human development, each era has representative and unique forms of art and design. For example, during the hunting era, humans drew images of cows on cave walls and tied sharpened stones onto wooden sticks to design hunting spears; In the era of agriculture, humans no longer have to chase their prey all day long. They can sit down and create painting art, design efficient agricultural products, and exquisite buildings on pottery pots and bowls with peace of mind; In the industrial age, humans created art in more replicable ways. Art and design have become a profession with a high degree of integration with modern science and technology in multiple fields[7]. If not adjusted, the interdisciplinary characteristics of the knowledge system of art and design will become increasingly apparent, and the various drawbacks of art and design in disciplinary construction will also be highlighted [8]. In Paper Cuttings design, computational creativity provides a new way to realize the art of Paper Cuttings. By simulating the process of human creative thinking through algorithms, artificial intelligence can automatically generate design solutions with aesthetic value. The application of learning algorithm in pattern recognition is of great significance for analyzing and learning Paper Cuttings patterns.

## 2.2. Artificial Intelligence Aided Paper-cut Design Process

In terms of performance techniques, paper-cutting is actually cutting and engraving on paper to show the image to be expressed. The broad masses of working people rely on their own intelligence and wisdom, and in the long-term life practice, they artistically express their daily work activities in this special artistic form, and have been tempered over time to become more and more perfect. Formed a variety of techniques based on cutting, engraving and hollowing out, which made the expressive force of paper-cutting infinite in depth and breadth. Fine as silkworms spin silk, thick as a large brush. According to the analysis of paper-cut patterns, according to the different functions, we divide the patterns into three categories. The first category is the patterns that outline the graphic structure of paper-cut manuscripts, which can be composed of geometric patterns; The second category is the specific patterns that express the image of paper-cutting, such as the horns and mouths of animals; The third category is the decorative pattern used to modify the image of paper-cutting, which can be composed of crescent pattern, flower pattern and sawtooth pattern [9]. In the selection of design scheme, this paper adopts the way of manual interaction, and the fitness value is given by the designer. With the increase of interaction, the design Agent will automatically save the fitness value of the designer to various schemes, which makes the human-computer interaction less and less. After the above operations, if the generated results meet the designer's requirements, they will be saved; otherwise, the patterns can be modified by copying, dividing, moving, rotating and scaling individual patterns in the visual environment .

## 2.3. Generation and iteration of Paper Cuttings patterns

Paper Cuttings art is very popular, and works are spread hand in hand. Its transmission method is also relatively simple and easy to understand: one is the method of replacing samples with smoke, and the other is the method of simulating through memory. For example, in tradition, it is often the wife of the Zhang family who uses the appearance of the Li family's wife, while the daughter of the Wang family also applies the pattern to the husband's family surnamed Liu. In the process of Paper Cuttings, people have the right to change the original at will according to their own ideals and aesthetic preferences, and it is simple, changeable and feasible. In this way, the initial form of the work will inevitably undergo inevitable changes. This variation in inheritance also constantly adjusts the differences between folk Paper Cuttings and the times, nationalities, regions and customs it spreads.

## 2.4. Innovation of Paper-cut Design Driven by Artificial Intelligence

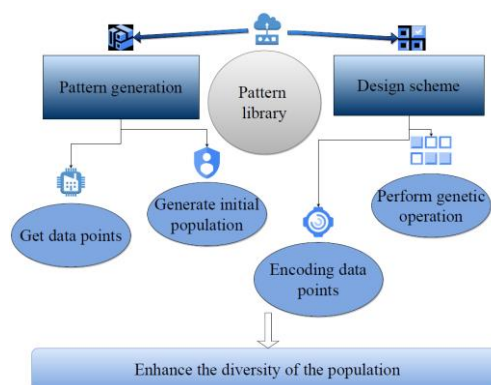


Figure 1: Overall structure of innovative design system for paper-cut patterns

The innovative design scheme for forming paper-cut patterns consists of three parts: pattern

generation based on complex coding genetic algorithm; pattern library management; and design scheme generation based on product feature tree. The overall structure of the system is shown in Figure 1.

In the pattern generation stage, the data points are obtained by edge extraction tools to generate the initial population, and the two-dimensional characteristics of complex numbers are used. Chromosome double-stranded structure is used to encode data points, and genetic operations such as crossover and mutation are performed. Smoothing factor and uniformity factor are introduced into fitness function to enhance population diversity.

### 3. Innovative design methodology of paper-cut patterns

#### 3.1. The Formation and Development of Design Theory

Modern paper-cut art graphics are square characters that have evolved over a long period of time on the basis of words. With the development of the times, looking at it from a broader information platform, Chinese characters and picture forms, which have never been divorced from the "image" and "shape" of everything in the world, and are highly simplified and generalized, are undoubtedly an artistic design element with deep vitality and appeal. Apply it to modern design art, and open up a creative space full of vigor and vitality for modern design art. In this paper, the innovative design of paper-cutting through artificial intelligence technology mainly includes design aesthetics, semiotics and cultural context analysis.

#### 3.2. Artificial Intelligence Aided Paper-cut Design Strategy

In our country's Paper Cuttings art design, this kind of unified, vivid, rhythmic and rhythmic aesthetic sense, dynamic and static, sparse and dense, diverse and unified, guests echo, virtual reality, vertical and horizontal, black and white contrast, overlapping and interlacing, and other traditional composition rules are common. The material language that expresses the emotions of Eastern culture through the processing and transformation of Chinese folk customs becomes a visual element of the charm of Eastern art that the audience can directly see. This kind of behavior carried out by artificial intelligence may not be called artistic creation, as it does not express its emotions through works and has no creative intention. But as viewers, we seem to have gained some additional interpretations and feelings from the work, as if this artificial intelligence program feels like a 'painter'. The speed at which computers learn painting styles is very fast. Perhaps it takes years for humans to master a certain style, while computers only need a few minutes to extract a certain painting style and proficiently assign any input content to this new style. Exquisite patterns made using laser cutting machines. Each work is exquisite and vivid. As shown in Figure 1, the cock in the Paper Cuttings pattern is holding his head high, which seems to be crowing in the sky, with a manly air.



Figure 2: Paper Cuttings under AI

Design itself requires designers to comprehensively apply graphics, text, color, and layout to artistic images, so that they have a certain degree of logic and display function, and can make people think and see things. Therefore, regardless of the form of creation, it must be combined with the history, culture, and art of the nation, as well as with the emotional and spiritual aspects of people. Paper Cuttings works use AI related technologies, including natural language processing, speech recognition, speech synthesis, etc., and take physical robots and virtual robots as carriers to create and show the possibility of interactive experience of art between machines and between people and machines.

#### 4. Conclusions

In this study, we explored the application of artificial intelligence technology in traditional paper-cut pattern design, aiming at promoting artistic innovation and optimizing the design process. The design process and methodology of AI-aided paper-cutting proposed in this paper provide artists and designers with new tools and ideas, so that they can create paper-cutting works with traditional cultural characteristics and modern aesthetics. It shows the great potential of artificial intelligence technology in promoting the integration of culture and art, and opens up a new path for the inheritance and innovation of traditional culture and art through the assistance of technology. Although some achievements have been made in this study, there are still challenges in the generalization ability of the algorithm, personalization of design and deep understanding of culture. Future research can be devoted to improving the creativity of the algorithm, enhancing the cultural sensitivity of the model, and exploring a more in-depth man-machine collaborative design model. Artificial intelligence can not only accelerate the design process and improve the design efficiency, but also inject new vitality into the innovation of paper-cutting art while maintaining the cultural tradition. With the progress of AI technology, we expect to see more interdisciplinary innovative practices in the future, providing more possibilities for the inheritance and development of traditional art.

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