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# *Innovative Research on Graphic Design of Intangible Cultural Heritage Display Information Assisted by Artificial Intelligence — A Case of Shanghai-style Paper-cutting Exhibition Design*

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***Abstract:*** Intangible cultural heritage (ICH) constitutes a precious spiritual asset of humanity, embodying rich historical and cultural significance. As a nationally recognized ICH item, Shanghai-style paper-cutting showcases the regional folk customs and historical transformations of Shanghai through its distinctive artistic style and profound cultural connotation. In the context of rapid digital technological advancement, how to leverage artificial intelligence (AI) to improve the efficiency and quality of graphic information design, thereby enhancing the communication effectiveness of ICH, has become a pertinent topic for in-depth study. This paper explores a practical application of AI-assisted design using Stable Diffusion in the exhibition design of Shanghai-style paper-cutting within an ICH pavilion. It aims to provide reference and inspiration for AI-assisted graphic design of display information.

***Keywords:*** Intangible Cultural Heritage, Graphic Information Design, Artificial Intelligence, Assisted Design

## 1. Introduction

Intangible cultural heritage is a vital part of humanity's spiritual wealth, encompassing profound historical and cultural meaning. As a nationally listed ICH item, Shanghai-style paper-cutting vividly reflects the region's folk traditions and historical evolution through its unique artistic style and cultural depth. In the current era of rapid digital development, how to apply AI to improve the efficiency and quality of graphic information design and thus strengthen the dissemination of ICH is an important and timely research topic.

## 2. Characteristics of graphic information design in ICH display

### 2.1. The complexity and abstraction of ICH culture

The abstract nature of intangible cultural heritage (ICH) symbols is reflected in the fact that many core elements of ICH projects are not concrete physical objects, but rather abstract concepts imbued with profound cultural significance, dynamic processes of craftsmanship, or oral traditions that exist only within specific cultural contexts. The complexity of these symbols stems from the diverse

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cultural dimensions and intricate technical details involved in ICH projects. Taking Shanghai-style paper-cutting as an example, its patterns integrate a variety of elements including the natural scenery of Jiangnan's water towns, urban aesthetics, and mythological narratives. These elements intertwine to form a complex and richly layered symbolic system. In exhibition design, it is essential to deeply analyze the structural logic and cultural meanings behind these symbols and present them to the audience in a clear and concise manner, so as to avoid confusion or ambiguity caused by their inherent complexity[1].

In this process, the introduction of artificial intelligence (AI) technology offers a promising solution. Through techniques such as natural language processing, AI can extract key information from vast amounts of text and imagery, identify the characteristics of cultural elements, and generate corresponding visual graphics.

### 2.2. Dynamism and interactivity in ICH displays

ICH is a living culture, and many projects—such as traditional dance and music—are passed down and developed through performance and interaction. Shanghai-style paper-cutting also includes elements like the creative process of cutting and interactive teaching. Therefore, graphic information design should reflect this dynamism and interactivity, incorporating animated graphics, video content, and interactive installations to allow audiences to experience the vitality and charm of ICH. AI applications further enrich the expressive forms of dynamic displays. Through machine learning and data analysis, AI can identify and predict audience interests and behaviors, intelligently recommending related dynamic display content. This enhances audience engagement and satisfaction, while also boosting the communicative effectiveness of ICH culture.

## 3. Feasibility strategies for integrating AI-assisted technologies

### 3.1. Natural language processing and information extraction

Artificial intelligence (AI) can rapidly process data related to intangible cultural heritage (ICH), such as textual and visual materials, and extract key information. With the continuous advancement of natural language processing (NLP) technology, AI is now capable of performing in-depth analysis and comprehension of large volumes of textual data. In the context of Shanghai-style paper-cutting research, AI can mine relevant literature to quickly identify key features and developmental trajectories of the art form. For instance, by conducting semantic analysis of historical documents on Shanghai-style paper-cutting, AI can recognize changes in stylistic features across different periods and uncover the underlying socio-cultural factors driving these shifts.

### 3.2. AI-assisted image generation technology

The primary AI-assisted method employed in this study for graphic information design is Artificial Intelligence Generated Content (AIGC). Currently, mainstream AIGC tools for image generation include DALL·E, Midjourney, and Stable Diffusion[2]. This study selects Stable Diffusion as its main research tool.

Stable Diffusion is an AI-based image generation tool that allows users to input prompts freely, upon which the system automatically produces artistic renderings. The core principle behind Stable Diffusion involves gradually adding noise to distort training data and then learning how to reverse this process in order to generate new images. More specifically, it begins with random noise as the initial input and gradually reduces the noise through a series of iterative steps, incorporating textual information into the process to guide the image generation outcome.

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## 4. Subjectivity and originality in the AI-assisted design process

### 4.1. Constructing a human-AI collaborative workflow

AI-assisted design is not solely dependent on technology; rather, it requires the construction of a human–AI collaborative workflow in which the designer takes the lead and AI plays a supporting role. In the case of Shanghai-style paper-cutting design, for example, AI is used to generate initial draft patterns, which the designer then optimizes and adjusts according to stylistic, thematic, and cultural connotation requirements. This allows the designer to exercise subjective initiative, ensuring that the final design aligns with the intended display objectives. The human–AI collaboration model leverages the respective strengths of AI and human designers. While AI can rapidly generate a wide range of patterns and design proposals, providing abundant creative inspiration and choices, these outputs often require further refinement by designers to ensure cultural authenticity and alignment with the unique characteristics of Shanghai-style paper-cutting.

### 4.2. Proactive intervention and adjustment of AI limitations

Although AI performs well in image generation, it is limited in its deep cultural understanding and creative expression, particularly when it comes to conveying the deeper meanings of Shanghai-style paper-cutting. The content it produces may lack cultural depth or nuance. To address this, designers must proactively intervene and make adjustments to AI-generated outputs, drawing on their own cultural knowledge and artistic sensibility to reinterpret and refine the designs creatively and meaningfully.

### 4.3. Ethical issues and originality in design

In the context of AI-assisted design, issues surrounding originality and design ethics have become prominent. Can AI-generated graphics be regarded as the designer's original work? How can designers maintain independence and cultural authenticity in the creative process while using AI tools? These questions must be addressed through practical exploration and critical reflection in design practice[3]. As the author and designer, I strictly adhere to copyright regulations throughout the design process, ensuring that the AI tools and data sources used are legally obtained. Additionally, I conduct cultural verification of the AI-generated graphics to ensure they align with the value systems and aesthetic standards of the target culture.

## 5. Practical application of AI-assisted design

### 5.1. Background and objectives

This practical study aims to explore the application of artificial intelligence (AI) in the design of intangible cultural heritage (ICH) exhibitions, with the goal of improving design efficiency and quality, and enhancing the display impact and cultural transmission of Shanghai-style paper-cutting.

As a significant cultural heritage of the Shanghai region, Shanghai-style paper-cutting possesses a rich historical background and profound cultural connotation. However, with the acceleration of modernization, this traditional art form faces dual challenges of preservation and innovation. The intricate craftsmanship and lengthy learning process involved in traditional hand-cut techniques have led to declining interest among younger generations, creating a gap in inheritance.

Against this backdrop, the study utilizes Stable Diffusion AI technology to explore new approaches and pathways for the graphic information design of Shanghai-style paper-cutting. By leveraging the image generation and data processing capabilities of Stable Diffusion, more visually engaging and contemporary design outputs are created and integrated into exhibition settings.

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## 5.2. Design process using stable diffusion AI software

### 5.2.1. Data collection and preparation

Works were collected from the “Chinese Paper-cutting Digital Space” and online sources, resulting in a database of 50 images of Shanghai-style paper-cuttings. This database served as the data foundation for AI training and image generation. Due to differences in resolution and format between images collected online and those from the digital archive, standardization was essential before using the images to train the AI model. As shown in Figure 1, the author employed Birme (Bulk Image Resizing Made Easy), a batch image adjustment tool, to uniformly resize the images to 512 pixels and convert them to PNG format to meet the model's training requirements[4].

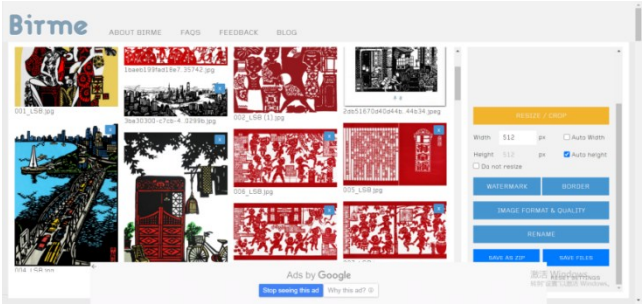


Figure 1: Resizing paper-cut images and constructing the database

### 5.2.2. Model training and optimization

In the training phase, the Stable Diffusion software’s model training function was used, with the constructed image database of Shanghai-style paper-cuttings input into the system. As shown in Figure 2, during training, various parameters—such as learning rate and iteration count—were continuously adjusted to optimize the model’s performance and generation quality.

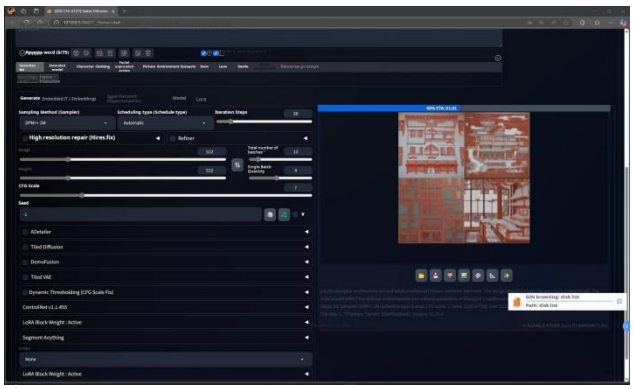

Figure 2: Model training interface for Shanghai-style paper-cutting images

### 5.2.3. Image generation and selection

Based on the thematic and stylistic requirements of Shanghai-style paper-cutting, the trained Stable Diffusion (SD) model was used to generate a series of graphic design schemes, as shown in Figure 3. These outputs included a variety of themes and styles, ranging from traditional floral and architectural patterns to creative designs infused with modern elements.

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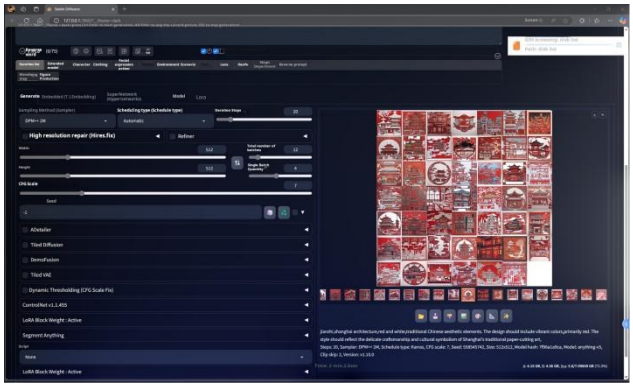

Figure 3: Interface for image generation using the trained model of Shanghai-style paper-cutting

To ensure the generated graphics met the design standards, a strict screening process was carried out. The images were evaluated in terms of compositional integrity, stylistic accuracy, and visual appeal, and only those that best aligned with the design goals were selected for further refinement. This process provided a rich pool of materials for the subsequent design stages.

### 5.2.4. Image optimization and enhancement

During the optimization phase, image editing software such as Photoshop was used to fine-tune and enhance the selected images. Adjustments were made to color, contrast, and detail resolution to improve the visual quality and artistic expression. The symbolic elements and graphic structures were thoroughly reviewed and optimized to ensure accurate communication of the cultural connotations and artistic features of Shanghai-style paper-cutting, in alignment with the goals of graphic information design. As illustrated in Figure 4, certain architectural patterns of Shanghai were simplified and refined to make them more legible; color schemes were adjusted to enhance both visual attraction and cultural expressiveness.

Figure 4: A panoramic Shanghai-style paper-cutting scroll depicting the scenery along Suzhou Creek in Shanghai

## 5.3. Design outcomes and applications

The AI-assisted graphic designs were seamlessly integrated into the exhibition space. Within the ICH pavilion, these informational graphics were used to support the Shanghai-style paper-cutting exhibit. High-quality works were presented on display walls, while interactive experience zones allowed visitors to engage with and better understand the culture and techniques of paper-cutting. This approach yielded effective exhibition results, as illustrated in Figures 5 and 6.

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Figure 5: Rendering of the “Shanghai-style paper-cutting” exhibit design

Figure 6: Rendering of the “Shanghai-style paper-cutting” exhibit design

## 6. Conclusion

Artificial intelligence has opened up new pathways for the graphic information design of intangible cultural heritage (ICH) exhibitions. Through the practical application in the Shanghai-style paper-cutting exhibit, this study demonstrates the great potential of AI in improving both the efficiency and quality of design, while also enhancing the overall exhibition impact[5]. Looking ahead, as AI technologies continue to evolve, we anticipate an even greater role for AI in the preservation, transmission, and innovation of ICH, enabling traditional cultural forms to shine with renewed brilliance in the digital age.

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