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# Style Transfer Technology of Batik Pattern Based on Deep Learning

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**Abstract**

AI painting has recently come into public view, improving the efficiency of users' creations. At present, the research and application of popular products such as characters and landscapes are more, but the research of Miao batik patterns is lacking. Therefore, this paper studies the style transfer of batik patterns from two aspects. First, a local style transfer model of batik patterns with enhanced edges is proposed. The loss function is composed of local content loss, local style loss and Laplacian loss, and the generated images have good performance in detail texture and color space. The other is to use the existing model in the AI painting tool Stable Diffusion for style transfer of batik patterns. It performs well in running time and memory occupation, but the generated image cannot inherit the style and content images well in color and detail.

*Keywords*: Style Transfer; Edge Enhancement; Mask Diagram; Miao Batik Pattern; Stable Diffusion

## 1 Introduction

Miao costume patterns are an important carrier of Miao culture. Their patterns are characterized by the interweaving of fantasy and truth, and the combination of abstract and concrete techniques, giving people a free, flexible, and imaginative visual experience [1]. In the past, pattern design was completed by textile computer-aided design software [2, 3]. However, with the development of computer technology, more research has shifted towards applying deep learning to the field of textile and garment [4-6]. Therefore, the style transfer between Miao clothing pattern images and artistic style images can better generate novel artistic patterns and realise innovative designs of patterns. It plays an important role in the inheritance and development of Miao costume culture.

Style transfer technology based on deep learning is a new means of image processing; its main task is to transfer the style of one image to another. At present, there are three main types of style transfer techniques: Style transfer based on VGG (Visual Geometry Group) [7], image generation based on GAN (Generative Adversarial Network) [8] and image generation based on Diffusion [9]. Style transfer based on the VGG model is proposed by Gatys, which extracts

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advanced abstract features of images through a pre-trained VGG model to realize distribution matching of feature space as well as constructed Gram matrix as the representation of image style features. By iteratively optimizing the initial white noise image, the differences of content features and style features between the generated image and the input image are minimized, and image style transfer is realized. Subsequently, the style transfer technology based on VGG has received extensive attention and research [10,11]. This kind of algorithm can well represent the style. However, the details and depth information of the content are difficult to retain, and it relies on the feature extraction network with huge parameters. Gan-based image generation was proposed by Goodfellow, which makes the generative network G and the discriminative network D compete with each other. G is committed to generating fake data, and D is committed to identifying fake data. Many researchers have used generative adversarial networks for image style transfer [12,13]. This algorithm can make images' style transfer effect more realistic. However, the stability of the model is not high, prone to mode collapse or low-quality output, and it needs to rely on a large amount of data and carefully adjust the hyperparameters and loss function. Diffusion-based image generation was first proposed by Jascha [14], and the DDPM (Denoising Diffusion Probabilistic Models) model proposed by Jonathan [15] in 2020 has shown excellent results in image generation tasks. Diffusion models receive much attention and have gradually replaced GAN as the mainstream. Its basic principle is to gradually add Gaussian noise, namely labels, to the original image in the forward process to help the neural network learn denoising, to gradually predict the target distribution in the backward process to obtain the denoised image. Diffusion models can also be used for style transfer of images [16,17]. These algorithms can generate high-quality images in a continuous latent space but require a large model capacity.

The research on style transfer technology of traditional clothing patterns has just started in recent years, mainly focusing on the original generation of traditional patterns. For example, Hou applied style transfer technology to generate cross-stitch technology of Miao clothing patterns [18]. Deng proposed an improved neural style transfer algorithm, which realised the transfer of brocade style to any content image [19]. In the innovative generation of traditional patterns, Zeng used two rapid style transfer techniques to transfer traditional Xilankapu patterns and icons to generate patterns with modern pattern semantics and strong traditional Xilankapu geometric style [20]. Wu proposed ClothGAN, which uses generative adversarial networks to generate new clothing styles and then uses style transfer algorithms to obtain Dunhuang style patterns [21]. However, due to traditional patterns' complex structure and variable lines, there is a high demand for details and textures in style transfer. However, current research in the field of innovative generation of traditional patterns mostly focuses on the transfer of different styles, and lacks improvement in the clarity of generated pattern textures.

The current image style transfer algorithm has problems with blurry edge details and uneven color in Miao batik pattern synthesis. Therefore, based on the original transfer model, this paper proposes a local style transfer method of batik pattern based on edge enhancement, which can effectively improve the effect of local pattern transfer and edge detail enhancement. In addition, this paper applies the open source tool Stable Diffusion to carry out the style transfer of Miao batik patterns on the existing model, and compares and analyzes the generation effect, to obtain the appropriate parameter Settings, which provides reference for users of this tool. In short, the generation of innovative patterns through style transfer technology can provide creative inspiration for professional designers and improve efficiency, but also be applied to clothing textiles through industrial ways such as printing and dyeing, broadening the transmission channels of Miao patterns.