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Application Research of Artificial Intelligence in the Innovation of Zhuang Brocade Digital Art: Taking "The Speech of Zhuang Brocade" as an Example

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Abstract

Purpose: Based on the dilemma faced by the digitization of Zhuang Brocade intangible cultural heritage in Guangxi and the analysis of the advantages of artificial intelligence art in the digitization and innovation of intangible cultural heritage, this study explores the application path of the digital inheritance and dissemination of Zhuang Brocade in Guangxi by relying on the current theory and practice of artificial intelligence art, and provides reference significance for the inheritance and dissemination of intangible cultural heritage through artificial intelligence art. **Method:** Through in-depth analysis of the types, characteristics, and cultural connotations of Zhuang Brocade patterns in Guangxi, machine learning is performed using StyleGAN's adversarial neural network, and digital art works are generated by applying Clip-style. The feasibility of developing digital resources for Zhuang Brocade intangible cultural heritage is explored through artistic practice, and an application process and implementation strategy for digital art innovation are proposed. **Result:** It is feasible to create NFT digital collections through artificial intelligence art to achieve the application scenarios of digital inheritance, innovation, cross-regional dissemination, and even industrialization of Zhuang Brocade in Guangxi. **Conclusion:** Artificial intelligence art creation can provide new opportunities for digital cultural dissemination and inheritance of Zhuang Brocade while reflecting its cultural connotations and characteristics, and ensure traceable development while ensuring intellectual property rights. It realizes the continuation and revival of the value of Zhuang Brocade in Guangxi, and provides a certain reference for the inheritance and development of other intangible cultural heritage in the current context of rapid media updates and iterations.

Keywords

Artificial Intelligence, Zhuang Brocade, Digital Art Innovation

1. Introduction

Zhuang brocade is one of the representative intangible cultural heritages of the Zhuang ethnic group in China, with vivid patterns, colorful colors, and a strong ethnic style. In the long process of historical development, Zhuang brocade has gone through a process from prosperity to prosperity, and from prosperity to decline. With the development of society and the impact of the times, Zhuang brocade faces four major challenges in the process of dissemination and inheritance: gradually shrinking production, shortage of skilled artisans, sharp decline in daily use, and complex weaving techniques. The digital inheritance of Zhuang brocade started relatively late, and many scholars, researchers, and craftsmen have been constantly exploring this path. However, the digital technologies currently used have their own disadvantages, such as CAD computer-aided design, which is limited by the use of software tools, and the patterns drawn are regular but lack flexibility, sometimes limiting the creativity of designers. Although 3D printing technology has to some extent liberated the hands of craftsmen, it is limited by 3D printing materials and coatings, making it difficult for 3D printing products to compete with the precision of manual production; The digital image recording of traditional ethnic skills requires long-term and in-depth tracking and investigation as the foundation, which requires high requirements for the production team; A major obstacle to the widespread application of high cost VR technology [1].

With the rapid development of information technology, "artificial intelligence" has become the mainstream trend of the times, and the protection and inheritance of intangible cultural heritage is also the emergence of cultural and artistic innovation. The integration of artificial intelligence technology and intangible cultural heritage provides new possibilities for the innovation of Zhuang brocade digital art. The StyleGAN adversarial network using artificial intelligence art can generate unique patterns infinitely. By preparing datasets, optimizing data features, loading model training, and randomly generating patterns, Zhuang brocade culture can utilize artificial intelligence technology to randomly generate rich and diverse patterns, meeting the public's pursuit of uniqueness and personalization needs. Artificial intelligence image stylization tools can integrate traditional Zhuang brocade patterns with modern styles, achieving innovation in intangible cultural and artistic heritage. These tools utilize CLIP Guided Diffusion technology for image generation, which can create beautiful images from simple text input. CLIP is an image recognition tool that can be combined with diffusion technology to iteratively guide the denoising process and generate images that match text prompts [2]. The artificial intelligence art

tool based on CLIP technology has excellent performance in generating texture images, which is very consistent with the texture attributes of Zhuang brocade patterns. By utilizing the big data behind artificial intelligence, patterns can be generated by simply inputting keywords, which is of great significance for the style evolution and cultural inheritance of Zhuang brocade patterns.

2. Cultural Connotations and Pattern Types of Zhuang Brocade

Zhuang brocade is an exquisite textile art form of the Zhuang people, woven using a technique called "warping and weft-cutting, with pattern on the warp thread". It features unique designs, vivid colors, durability, and rich cultural connotations. The Zhuang people have a deep love for Zhuang brocade, and there are many beautiful legends about it in folklore, such as "A Piece of Zhuang Brocade", "Bao Sang and Qiao Ni", and "Da Wang". These enchanting and mystical stories not only add mystery and brilliance to Zhuang brocade, but also depict a blueprint for happiness and express their wishes in a vivid way.

The patterns of Zhuang brocade are also steeped in history and profound cultural meaning, with a strong ethnic character. Most of the designs are derived from nature, daily life, totem worship, and the aspirations for a better life of the Zhuang people. Following traditional practices, they skillfully summarize and exaggerate certain forms from nature, boldly simplify and choose the objects to be depicted, creating graphic designs that are both unique and highly expressive, forming a distinctive graphic language of the Zhuang people [3]. Zhuang brocade patterns can be divided into four categories. The first category consists of geometric patterns, which originated from ancient traditional culture and have been passed down, such as diamond patterns, triangular patterns, cloud and thunder patterns, etc. The second category is made up of numerous totem-themed patterns that arise from Zhuang culture itself and are closely related to the Zhuang people's unique spiritual world and aesthetic consciousness.

For example, the Zhuang people view the phoenix as an auspicious omen, the flower patterns come from their worship of the flower goddess, dragon (snake) patterns express the Zhuang people's desire for safety, and frog patterns convey their hope for good weather and a bountiful harvest. The third category includes patterns that are identical to those found in Han Chinese auspicious culture, such as the "swastika" symbol, the "shou" character, the ruyi (scepter) pattern, etc. These patterns have been a dominant theme of Zhuang brocade from the Ming and Qing Dynasties to the modern era. The first three categories of patterns are often used interchangeably. The fourth category is a recent development in Zhuang brocade design, which is closely related to contemporary life and social spirit, such as Liu Sanjie and Guilin landscape patterns.

3. StyleGAN Artificial Intelligence-Generated Zhuang Brocade Patterns

Relatively little image data is available for the Zhuang brocade pattern. The au-

thor has captured and scanned nearly 200 pattern images from the Zhuang brocade pattern album and related literature materials, and classified and organized them mainly based on different texture pattern types. The scanned images have different orientations, sizes, and specifications, so they need to be optimized. Optimization tools can use Photoshop software or XnConvert batch processing tool. The advantage of the former is that it can personalize the processing of each image pattern by cropping the canvas, adjusting the size, and color, etc., while the latter is a powerful image batch processing software that supports more than 80 image formats conversion and editing, including JPG, PNG, GIF, BMP, ICO, RAW, and other commonly used formats. It also supports batch renaming, size adjustment, cropping, rotation, adding watermarks, adjusting colors, and other functions, which can greatly improve users' work efficiency. In addition, XnConvert also provides many advanced functions such as image adjustment and filters, exposure, contrast, saturation, and hue adjustment. XnConvert has an intuitive user interface, easy to use, and supports cross-platform operating systems such as Windows, macOS, and Linux.

Its advantage is that it can process and generate multiple images based on the same settings, greatly improving creativity efficiency. The Zhuang brocade pattern samples are mainly optimized from two aspects: texture pattern extraction and color tone processing. Different data samples can be obtained by extracting texture patterns from different parts of the same Zhuang brocade pattern. Multiple data samples can be extracted from a single Zhuang brocade pattern, increasing the number of the dataset. XnConvert batch processing tool can be used for texture pattern extraction by adjusting size, cropping, and canvas size. Set the width and height of the image to be the size of the required pattern, the mode to be "fill", and the cropping to be "start from the edge". Set the four parameters of up, down, left, and right to center the required pattern. For example, the width and height of the phoenix tree pattern Zhuang brocade in the resize are both set to 1520 pixels, and the cropping parameters for up, down, left, and right are 50, 77, 350, and 121, respectively, as shown in Figure 1.

Additionally, by adding curves and auto-contrast to the sampled pattern, the colors are more vibrant, the contrast between light and dark is more prominent, and more details are presented. The parameter settings are shown in Figure 2,

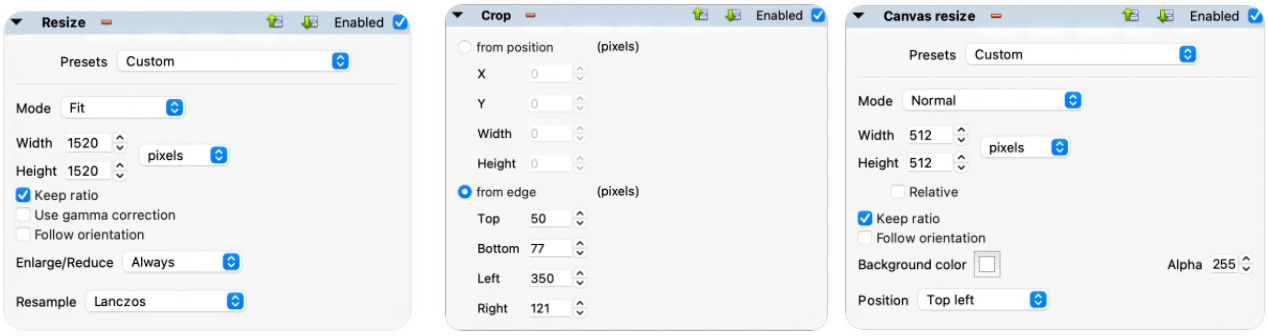

Figure 1. XnConvert resize, crop, and canvas size tools.

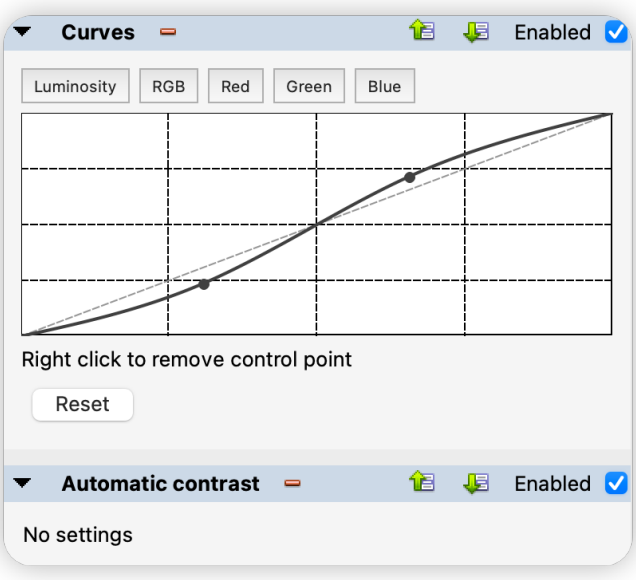

Figure 2. XnConvert color setting.

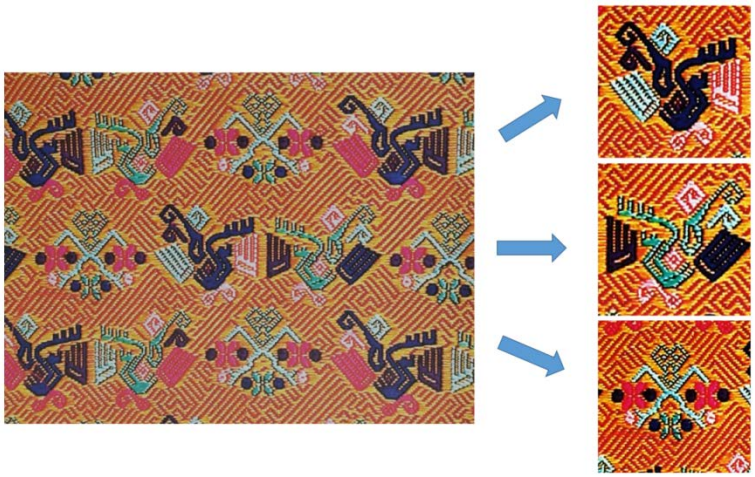

Figure 3. Extracting multiple pattern samples from Zhuang brocade patterns.

and the final cropped pattern sample is shown in Figure 3.

In the end, a total of more than 200 PNG format images with a size of 512*512 were generated and output as dataset samples, as shown in Figure 4.

By training the dataset of Zhuang brocade pattern samples using StyleGAN2-ADA-PyTorch, it is possible to generate good quality pattern images even with a small number of dataset samples. In this case, the WikiArt pre-trained model was used to start training at 272kimg, resulting in a model file. Finally, this model file was used to generate new Zhuang brocade texture patterns, as shown in Figure 5.

4. Disco Diffusion Is an AI application that Stylizes Zhongjin Patterns

StyleGAN is capable of generating new patterns that conform to the Zhuang

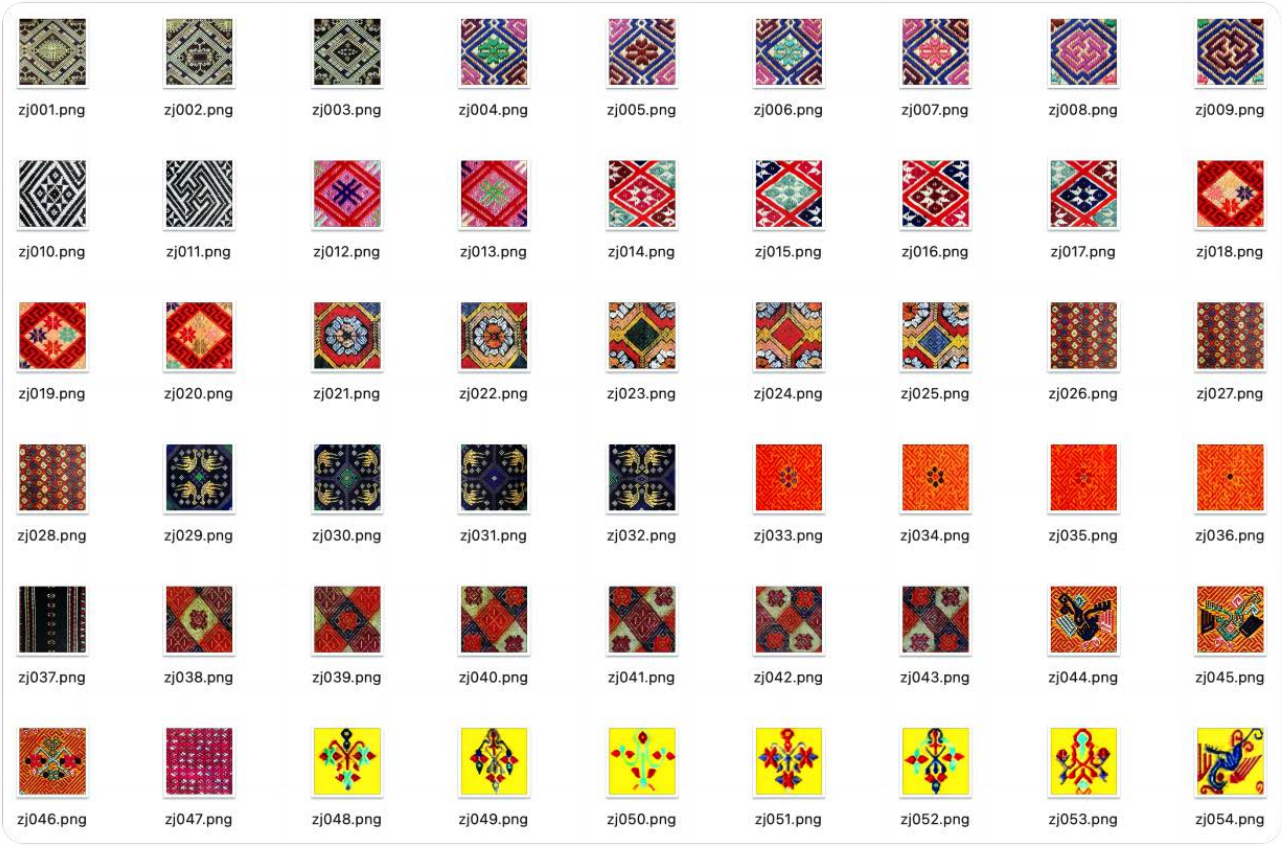

Figure 4. Dataset samples generated for the Zhuang brocade pattern.

Figure 5. New pattern generated by AI training using StyleGAN2-ADA-PyTorch.

brocade texture style using the original Zhuang brocade texture samples. Meanwhile, the Disco Diffusion style evolution can imbue the new patterns with soul and incorporate the cultural connotations of the Zhuang brocade.

The many legends surrounding Zhuang brocade provide abundant cultural elements for Zhuang brocade patterns. These legends are recorded and spread in the form of language and text. Disco Diffusion allows for the possibility of sty-

lized text images, with the Zhuang brocade texture pattern serving as the initial pattern for style evolution. This approach can not only preserve the unique charm of the Zhuang brocade texture but also blend it with other genres and styles, evolving into a new artistic style and endowing the Zhuang brocade with new life.

The form of generating animation through Disco Diffusion differs from traditional animation and is also an evolutionary process. It allows viewers to clearly see the entire process of transformation from pattern texture to legendary story scene, as shown in Figure 6.

The author used the Zhuang folk legends "Danimi" and "A Zhuang Brocade" as the story material, and used Disco Diffusion for the stylized creation of Zhuang brocade patterns, with the following specific steps:

First, the story is transformed into a storyboard script, similar to the production of traditional film and television animation scripts. Since the animation involves multiple different scenes, if the AI evolution calculation renders a multi-scene animation, more detailed parameter settings are needed, and therefore different scenes can be split for computation.

Second, in Disco Diffusion, the descriptive keywords determine the evolution style. Therefore, the AI animation script also needs to add descriptive keywords, such as painting schools, painters, landscapes, rendering engines, animation element weights, etc. However, because slight changes in these keywords will greatly affect the generated results, it is necessary to control variable tests for different keywords under the same parameter setting conditions to find a suitable result as the description keyword of the animation.

Third, the weight of the initial reference image and the number of steps skipped are set to preserve as many initial image elements as possible. The steps skipped are generally more than 50%. In the storyboard script, the duration of each shot is estimated based on the reading speed of the text. This animation uses 25 frames per second as the benchmark, and converts seconds to frames.

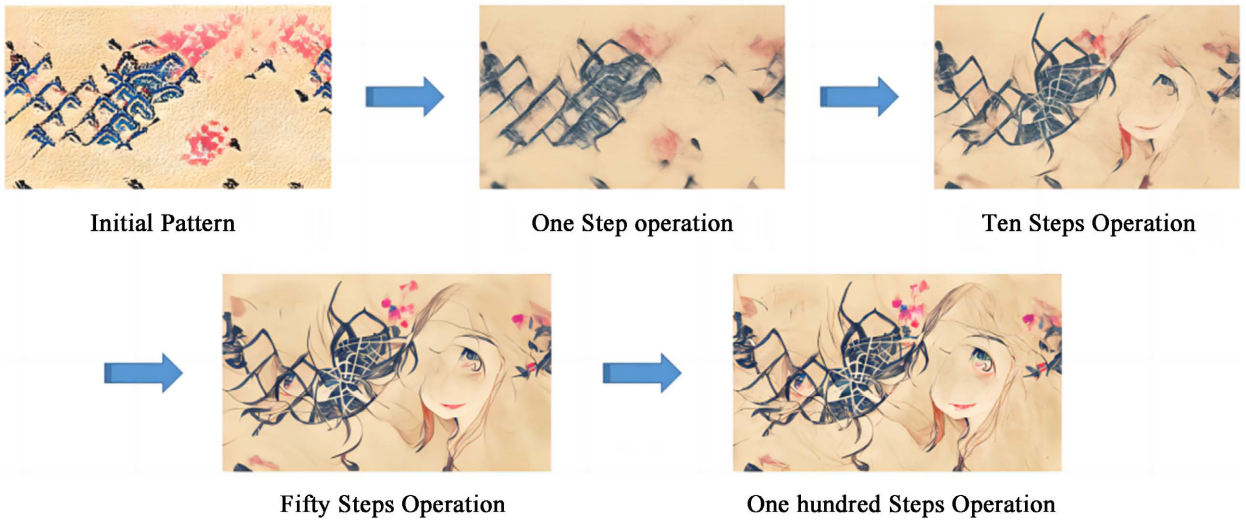

Figure 6. The process of Disco Diffusion style evolution for patterns.

For example, if the first shot lasts for 5 seconds, it is converted to 125 frames, which means that from frame 0 to frame 124, it is the first shot. Therefore, the corresponding keyframe value is added before the prompt text of each shot, as shown in Figure 7. This work uses 3D animation, and camera movement is added to enrich the visual effects. Finally, the main scene of each shot is compiled into text and added with painting schools, renderers, and other keywords to form prompt text for computation. The final result is shown in Figure 8.

Figure 7. The number before the Disco Diffusion prompts indicates the frame number.

Figure 8. Artistic effect of the Zhuang brocade AI animation.

In the above case study, artificial intelligence generates new patterns with the characteristics of Zhuang brocade patterns by learning from existing patterns. If different types of Zhuang brocade patterns are finely annotated, then each pattern can be digitally inherited and innovated, and more cultural and creative products or art forms can be derived. In addition, artificial intelligence technology can combine traditional Zhuang brocade textures with other artistic styles to create new artistic styles, which helps to meet the needs of diversity. The application of artificial intelligence technology can not only solve the problem of digital inheritance and development of Zhuang brocade patterns to a certain extent but also make a new attempt to combine traditional patterns with storytelling in animation production. One of the great features of artificial intelligence animation production is "evolution", which can achieve a smooth transition from Zhuang brocade patterns to the story scenes.

5. Conclusion

Under the background of informatization and modernization, traditional handicrafts must be combined with emerging disciplines to keep up with the times and meet the needs of the times. The development of new media technologies such as 5G and cloud computing provides a powerful computing basis for artificial intelligence artistic creation, and cloud rendering technology has broken through the constraints of local GPU computing. The rapid development of artificial intelligence technology provides technical support for the digital art innovation of Zhuang brocade intangible cultural heritage. The non-fungible tokens (NFT) generated by blockchain technology can be used to record the copyright and transaction records of Zhuang brocade digital art innovation products. This makes it possible to form an industrial chain of Zhuang brocade digital products in Web 3.0. This not only protects the intellectual property of Zhuang brocade digital products, but also helps to enhance the economic value of Zhuang brocade. In addition, by fully utilizing the advantages of artificial intelligence, Zhuang brocade intangible cultural and creative industries can be created through "new media + cultural and creative". This can help create a Zhuang brocade intangible cultural heritage brand, optimize the craftsmanship process and develop innovative patterns that meet the needs of today's market, and achieve the unity of technology and art. As artificial intelligence technology is updated and iterated, it will play a huge role in various industries, and the application scenarios will also achieve diversified development. It will also empower the digital dissemination and inheritance of intangible cultural heritage, deeply integrate cultural core values, and form the optimal fusion path of artificial intelligence technology and cultural and artistic innovation.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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