

Application Research of Interior Design Style Migration from the Perspective of Artificial Intelligence

Yangyang Li^{1,*}, Li Sun¹

¹ School of Art, Anhui University of Finance & Economics, Anhui, Bengbu, 233000, China

* Corresponding author: Yangyang Li (Email: YYLee0517@163.com)

Abstract: This article utilizes KuJiale application software as a case study to investigate the integration of artificial intelligence (AI) technology within the realm of environmental design. Employing style transfer algorithms, this study translates elements of flat design, elevations, and color compositions derived from exemplary design instances into interior design proposals tailored to user specifications, yielding distinctive artistic outcomes. The research undertaken herein substantiates the viability and scientific validity of implementing artificial intelligence style transfer algorithms in the realm of interior design. Furthermore, it furnishes novel insights and exemplars for the advancement of interior design endeavors.

Keywords: Artificial Intelligence, Interior Design, Style Transfer.

1. Introduction

With the rapid development of intelligent technology, artificial intelligence is no longer a concept confined to science fiction novels but has become an integral part of our lives. Intelligent applications have penetrated various fields, altering our work patterns, social interactions, and daily routines. In this era of intelligence, people have higher expectations for the design of their living spaces and environments. As living standards continue to rise, and aesthetic demands evolve, interior design has become increasingly crucial. However, interior design is often perceived as a complex and intricate task, involving considerations such as spatial layout, color combinations, and furniture selection. This has spurred the rapid rise of intelligent design platforms, which employ artificial intelligence technology to assist in the design process, offering new possibilities for creating more aesthetically pleasing, practical, and personalized interior spaces.

Within intelligent design platforms, style transfer technology has garnered significant interest and research. Style transfer not only allows designers to better understand and meet clients' aesthetic preferences but also facilitates the integration of various artistic styles, cultural elements, and design concepts into interior design, resulting in interior environments with unique visual appeal. By applying the visual elements of a particular artistic style to interior design, style transfer technology expands the creative space of designers, providing them with more inspiration and creative choices.

This paper aims to delve into the application of style transfer in interior design from the perspective of artificial intelligence, exploring how artificial intelligence technology can enhance the efficiency and creativity of interior design. To better comprehend this research topic, it is essential to first understand the fundamental concepts of artificial intelligence and style transfer. Artificial intelligence is a multidisciplinary field with the core objective of enabling computer systems to simulate and perform tasks associated with human intelligence. Style transfer, on the other hand, is an image processing technique that aims to apply the visual style of one image to another, creating a new image that retains the content

of the original while incorporating artistic elements of the selected style. Both of these concepts have achieved significant milestones in the fields of image processing and art, but their combined potential in the realm of interior design remains largely untapped.

To better appreciate the relevance between interior design and style transfer, we must consider the significance of interior design for individuals and society. Interior design is not merely a visual endeavor but also an art and science that influences people's lifestyles, work efficiency, and emotional experiences. It reflects culture, values, and individual needs. Therefore, studying how style transfer technology from the perspective of artificial intelligence can redefine approaches and innovations in interior design is of paramount importance in meeting people's demands for personalized, high-quality interior environments. The motivation behind this study lies in exploring how artificial intelligence is transforming the landscape of interior design and its potential impact on our lifestyles and environments.

In this paper, we will explore the application of style transfer technology in interior design and provide a detailed description of the research methods and experimental design. We will analyze the experimental results and discuss their significance, concluding with the key findings of this research and offering prospects for future research directions to advance the application and development of artificial intelligence in the field of interior design.

2. Background Overview

2.1. Style Transfer Principles

Style transfer refers to the process of transforming a target content image based on the feature information of a source style image. The objective is to synthesize a visually appealing effect that combines a new style with the content, resulting in an image that retains the shape and structural information of the target content while incorporating the color, texture, and other characteristics of the source style image. The choice of different source images determines the visual effects of the resulting image. Style transfer algorithms enhance the creativity and diversity of interior design.

2.2. Artificial Intelligence Models

Based on artificial intelligence, style transfer algorithms are implemented using the KuJiale network platform to facilitate style transfer designs with the assistance of mainstream models. KuJiale serves as a deep learning framework, known for its clarity, high readability, speed, and open-source nature within the field of artificial intelligence. Unlike traditional style transfer algorithms such as texture synthesis, Support Vector Machines (SVM), histogram matching, and automated sample collection, the style transfer algorithms employed in this paper are based on deep learning theory. Leveraging the KuJiale artificial intelligence network platform, they are capable of addressing prominent issues in style transfer, such as detail loss, distortion, and significant color variations, resulting in rich and unique visual effects. Mainstream models in artificial intelligence networks, including KuJiale, Table Diffusion, and GoogLeNet, require specific analysis and comprehensive consideration of model selection and parameter settings in the context of interior design style transfer.

3. Style Transfer Approach

Firstly, the sample illustrations are transformed into individual frames. Utilizing the MATLAB technology platform, preprocessing is applied to the images intended for transfer. This involves processing images from various perspectives and categorizing them by shots, then storing them as JPG format files. Secondly, style transfer is conducted. With the assistance of artificial intelligence networks and models, style transfer algorithms are employed to create style-transferred scenes categorized by shots. Thirdly, color correction is initiated. During style transfer, image damage or overexposure can sometimes occur. The nature of this damage is a noticeable change in brightness or hue. By employing color balancing for algorithmic correction, issues related to damage and overexposure can be addressed, achieving the best results. Finally, a comparison is made between practical cases and the results obtained from artificial intelligence style transfer.

4. Interior Design Style Transfer Practice

4.1. Model Selection and Parameter Optimization

Model selection and parameter optimization are critical steps in style transfer. Choosing the right model and parameters can efficiently produce high-quality stylized designs, achieving the goal of interior design style transfer. First, it is necessary to determine the choice between the three artificial intelligence models: KuJiale, Table Diffusion, and GoogLeNet. Each of these model categories has its advantages, and determining which model is suitable for interior design style transfer requires preliminary sample analysis. The style/content transformation ratio (1/5, 2/5) is a crucial parameter in style transfer, and the selection of parameters also requires prior experimentation. To this end, we have selected specific samples for style transfer design analysis.

Figure 1 shows the results of model and parameter comparisons. We found that setting the style/content transformation ratio to 1/5 results in insufficient style transfer and poor quality due to the excessively low ratio. It lacks

crucial information such as shapes and structures present in the samples. Regarding model selection, GoogLeNet exhibits significant errors in the arrangement of planes in style transfer, making it unsuitable for interior design style transfer. KuJiale and Table Diffusion, on the other hand, produce better style transfer results, especially when using a 2/5 transformation ratio, which yields optimal outcomes. Further comparing the model transfer results between KuJiale and Table Diffusion, we believe that the KuJiale model preserves fine details, exhibits reasonable structure, rich layering, and high transfer efficiency (highlighted in the red box in the figure). Therefore, we ultimately chose the KuJiale model with a 2/5 style/content transformation ratio for interior design style transfer.



Figure 1.

4.2. Style Transfer

With the support of artificial intelligence models, style transfer algorithms are used to import samples for transfer, following these specific steps: First, import the sample patterns. Second, perform style transfer sequentially, including plane style transfer, color transfer, and decorative style transfer. The chosen model is KuJiale, with a style transformation ratio of 2/5. Finally, utilize CUDA for computational acceleration in style transfer and output images in PNG format, thereby achieving the desired design effects.

Figure 2 displays the interior flat design style transfer results. The results indicate that, on one hand, style transfer retains essential information about the sample's architectural structure, layout, and other important elements while blending in the color elements of the target sample, creating a unique design effect. On the other hand, style transfer maintains good detail preservation, rich color layering, and does not exhibit style transfer errors like image distortion or layout disarray.



Figure 2.

Figures 3 and 4 depict interior design color style transfer. To validate the reliability and scientific nature of the color transfer algorithm, we specifically selected the 'Renminbi' (Chinese currency) with its rich color scheme as a color transfer experiment sample. The results indicate that, on one hand, style transfer preserves the crucial information of the sample while blending in the color elements of the target sample, creating a unique design effect when combined. On the other hand, style transfer maintains good detail preservation, rich color layering, and does not exhibit style transfer errors such as image distortion. Moreover, there are no issues of image blurring between the before and after states.

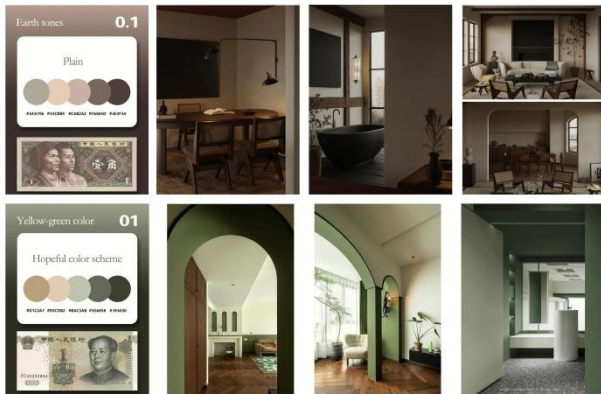


Figure 3.

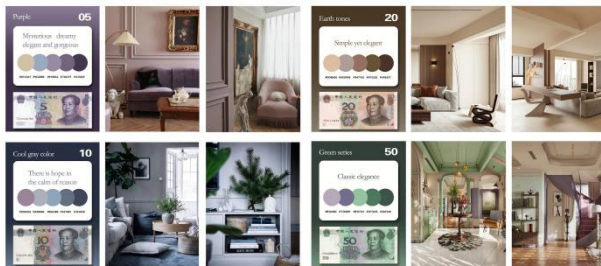


Figure 4.

Figure 5 depicts interior decoration style design style transfer. To validate the reliability and scientific nature of the decoration style transfer algorithm, we selected samples with fixed perspectives for the transfer experiment. The results indicate that, on one hand, style transfer preserves the crucial information of the sample while blending in the color elements of the target sample, creating a unique design effect when combined. On the other hand, style transfer maintains good detail preservation, rich color layering, and does not exhibit style transfer errors such as image distortion. Moreover, there are no issues of image blurring between the before and after states.

To validate the authenticity and effectiveness of the style transfer design results, we once again selected a set of different sample perspectives for transfer. This was done to determine the reliability and scientific nature of the style transfer algorithm in interior design. The specific steps and model parameters are the same as mentioned earlier.

Figure 6 displays the results of interior decoration style transfer with different sample perspectives. While preserving the target sample's shape and structural information and incorporating elements such as texture and color from the source style image to generate the design effect, we found that style transfer still has some issues in terms of detail. One notable problem is image overexposure

(highlighted in the red box in the figure), where certain areas exhibit deviations in hue and brightness, leading to less-than-ideal output results. Therefore, further processing is required using color balancing and correction algorithms to remove overexposure and achieve the best design effect.



Figure 5.



Figure 6.

4.3. Color Balance and Algorithmic Correction

Research has found that for the issue of overexposure in style transfer images, color balance algorithms based on the MATLAB technology platform can be utilized for correction. To address the secondary overexposure issues in the transferred images, it is only necessary to correct the color of the output image, specifically by using the $L\alpha\beta$ color space for color correction. In the correction of classified shots, an image represented in the RGB color space is selected. The image's R, G, and B channels are multiplied by unknown constants C_r , C_g , and C_b , which do not change the variance of the three channels in the $L\alpha\beta$ color space but alter the channel means. The means represent the overall color tone information of the image, so adjusting the channel means is sufficient to balance the tone of the frame, achieve color correction for images after style transfer, and eliminate overexposure. The specific steps are as follows: First, convert the image that needs correction from the RGB color space to the $L\alpha\beta$ color space. Second, calculate the means of the α and

β channels for that frame, denoted as $m\alpha$ and $m\beta$. Third, calculate the total number of pixels in that frame, denoted as N . Finally, adjust the means of the image and then convert the processed image back to the RGB color space.

Figure 7 displays the color correction results. Through comparison, we found that the deviations in hue and brightness in the areas marked with red boxes have been effectively corrected, and there is also a global enhancement in the image. The results indicate that using the color balance algorithm to repair secondary image damage in style transfer animations is effective. After correction, the animation exhibits vibrant colors and consistent tones. This demonstrates that the AI-based style transfer algorithm proposed in this paper is feasible for application in interior design.

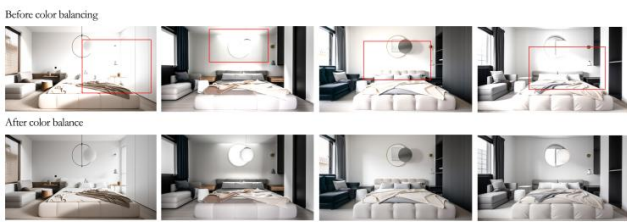


Figure 7.

4.4. Interior Design Comparison

We have selected interior scenes designed by designers from practical cases and compared them with interior designs completed using the artificial intelligence algorithm in this paper. For the practical case, we selected scenes including a bedroom, study, and dining room. In order to showcase the diversity and innovation of style transfer, we also chose these reference case scenes as source examples for different styles of interior transfer design.

Figure 8 shows the design comparison. The left example is the line-drawing sample scene from the practical case. The middle example is the designer's practical design sample, and the right example is the interior design effect achieved using the style transfer method. The results show that the animation effects designed using the method in this paper are close to the target style in terms of color and style. They have various artistic features, can be effectively transferred to the target pattern, resulting in interior design effects, and are efficient, easy to modify, and cost-effective.

The limitation is that it cannot arbitrarily change the structure and shape information of the target pattern. Style transfer can only be based on this information, lacking the flexibility of manual design methods. The results obtained from traditional design methods are reasonable in composition and relatively flexible in arrangement, with good integration of the subject and background. However, the drawback is that it takes a long time and has high production costs. Therefore, combining manual design with artificial intelligence algorithms in interior design can complement each other's strengths.

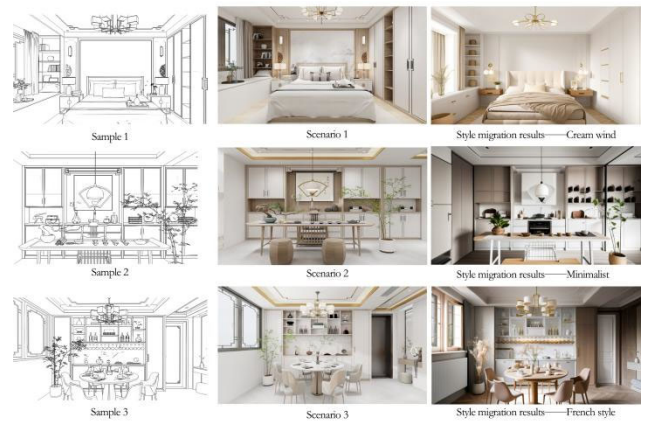


Figure 8.

5. Conclusion

The application research of artificial intelligence style transfer algorithms in interior design leads to the following conclusions:

(1) AI-based style transfer algorithms can rapidly and effectively generate diverse interior design styles. While creating unique and novel design effects, they significantly improve efficiency and save resources, providing strong technical support from an artistic perspective. This further expands the breadth and depth of interior design.

(2) Style transfer algorithm models and parameters need to be optimized. Research has found that the style/content conversion ratio and model selection. The design results show that, in the creative process, the optimal model is Kujiale, and the optimal conversion rate is 2/5. It should be noted that model parameter settings should be selected specifically based on different needs and should be determined through preliminary sample analysis to achieve the best results.

(3) In style transfer design, secondary issues such as image damage and overexposure often occur. These issues require further processing of the transferred images using color balance algorithms and relevant technical platforms to obtain high-quality design results. With the deep development of artificial intelligence and the cross-fusion of computer science and artistic design, on one hand, it can compensate for the shortcomings of traditional manual design methods, and on the other hand, it can stimulate new creativity in interior design, leading to new achievements.

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