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Computer-Aided Design AND APPLICATIONS

Intelligent Pattern Identification and Design of Garment CAD System Based on Computer Vision and Neural Networks

Caijun Wang[1] and Weixin Lin[2]

[1]Hainan Vocational University of Science and Technology, Haikou, Hainan 571126, China, wangcaijun8185@yeah.net
[2]Hainan Vocational University of Science and Technology, Haikou, Hainan 571126, China, weixin.lin@dpu.ac.th

Corresponding author: Weixin Lin, weixin.lin@dpu.ac.th

Abstract. Traditional garment design creativity results in low design efficiency and difficulty in ensuring design innovation. Therefore, how to improve the intelligence level of garment design has become an urgent task. Computer vision has achieved significant results in many fields. The identification in garment CAD systems is introduced by an Image Style Transfer (IST) method based on computer vision and neural networks. This article proposes an IST method based on a backpropagation neural network (BPNN) and applies it to pattern identification in garment CAD systems, thereby improving the intelligence level of garment design. This scheme introduces an attention mechanism to important pattern regions and improves the accuracy of identification. By introducing loss functions such as content loss and style loss, this algorithm can balance during the training process so that the generated pattern retains the original image and incorporates elements of the target style.

Keywords: Garment Design; CAD; Computer Vision; Bp Neural Network; Pattern Identification
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1 INTRODUCTION

The garment industry is a fiercely competitive market, and in order to stand out in the competition, designers need to innovate and design more attractive garments constantly. However, traditional garment design and the creativity of designers result in low design efficiency and difficulty in ensuring design innovation. It can help designers quickly generate and process visual images, thereby better expressing and conveying design concepts. Fan and Li [1] explore conveying visual image content and style in clothing design. Computer graphics processing technology can help designers quickly generate various types of visual images for clothing design, such as style drawings, renderings, and stereoscopic images. By using professional graphics processing software, designers can easily adjust parameters such as image size, proportion, and colour to achieve the best design results. The visual images of clothing design generated through computer graphics processing technology can intuitively convey the designer's design philosophy and style. These images can be used to showcase design works, communicate with clients, and promote markets. At the same time, designers can also share their design works with more people through online platforms and social media channels to expand brand influence. Therefore, how to improve the intelligence level of garment design has become an urgent task. AI has penetrated various fields of people's lives, bringing tremendous changes to various industries. Computer vision, as an important branch of AI, has achieved significant results in many fields. Fan et al. [2] explored clothing style recognition and design based on CAD system feature representation and collaborative learning. By combining feature representation techniques of CAD systems and collaborative learning algorithms, we can more accurately identify and design clothing styles. It first introduces the basic principles of CAD system feature representation and collaborative learning and then elaborates in detail on the clothing style recognition and design process based on CAD system feature representation and collaborative learning. CAD system is a computer-aided design system used for clothing design and manufacturing. In CAD systems, the style of clothing can be represented by a series of features, such as shape, colour, texture, etc. These features can effectively describe the style attributes and design elements of clothing. Collaborative learning is a machine learning method based on swarm intelligence, which can improve learning efficiency and accuracy through collaboration and knowledge sharing among multiple agents. In clothing style recognition and design, we can use collaborative learning algorithms to share and integrate the knowledge and experience of multiple designers. At present, most CAD systems can only achieve simple graphic drawing and editing functions and are often powerless for complex pattern identification and design.

Fathi et al. [3] explored a method for achieving deformable 3D shape matching of virtual clothing through Laplace Beltrami descriptors. Laplace Beltrami descriptors are an effective method for shape matching and recognition. By combining virtual reality technology, we can achieve deformable 3D shape matching of virtual clothes. Laplace Beltrami descriptors are an effective method for shape matching and recognition. It maps shapes to high-dimensional space, extracts shape feature vectors, and achieves shape matching and recognition. In the deformable 3D shape matching of virtual clothes, we can use Laplace Beltrami descriptors to extract shape features of virtual clothes, thereby achieving shape matching and deformation between different clothes. Input the extracted shape features into the matching algorithm to achieve shape matching between different clothes. On the basis of shape matching, virtual clothes are transformed to achieve style conversion and personalized design between different clothes. Pattern identification and design remain challenging issues in garment CAD systems. The IST method based on neural networks can transfer one style to another while preserving the original image content, thereby achieving style transformation and fusion. This article applies the IST method to pattern identification in garment CAD systems. Clothing design is a complex process involving multiple stages, including style design, fabric selection, cutting, sewing, etc. Traditional design methods often rely on the experience and intuition of designers, but this model cannot guarantee that more and more algorithms will be applied to clothing design. However, algorithms are not omnipotent and cannot completely replace human creativity and intuition. Therefore, how to better combine human creativity with algorithmic intelligence to achieve multi-link intelligent design of clothing products is a hot research topic at present. Han et al. [4] explored a new model of human algorithm collaborative design using Eastern European fibres and textiles as an example. Traditional design methods often rely on the experience and intuition of designers, but this model cannot guarantee more and more algorithms are being applied to clothing design, greatly improving the efficiency and accuracy of design. Textiles have unique characteristics and advantages, such as exquisite texture, soft colour, and excellent texture, making them widely used in clothing design. However, better utilizing these fibres and textiles for design requires a combination of human creativity and algorithmic intelligence.

These software not only have powerful image processing functions but also have various tools and modules required for clothing design, which can help designers quickly and efficiently carry out clothing design and production. Hsu et al. [5] explored software for the computer-aided teaching mode of clothing design to improve teaching quality and effectiveness. By introducing the basic functions and application areas of the software, this article elaborates on its role and advantages in clothing design teaching, provides a detailed explanation of the implementation process and precautions, and provides reference and guidance for educators in related fields. In clothing design teaching, basic operation training in computer graphic design software is essential. Students need to master the basic functions, interface layout, and tool usage of the software in order to proficiently carry out subsequent design operations. By analyzing excellent clothing design works, students can understand the characteristics and methods of clothing design with different styles and materials and combine practical cases to improve their practical operation ability and design level. Hu [6] proposed a style CAD system. The system adopts a component-based design method and achieves fast, efficient, and personalized clothing style design by building a reusable clothing style component library. The component-based intelligent clothing style CAD system adopts a component-based design method, abstracting the elements involved in the clothing style design process (such as a collar, sleeves, pockets, etc.) into reusable components. By building a clothing style component library, designers can select and combine different components according to their needs, quickly building clothing styles that meet personalized needs. The parameterized adjustment of components to meet the needs of different sizes and styles. This module is responsible for building and managing a clothing style component library. Designers can create new components as needed and name, classify, and parameterize them. This module provides user-system interaction functionality. Designers can modify and adjust the constructed styles through this module while also saving and sharing their own design works.

By introducing computer vision technology and neural network methods, this article proposes an intelligent pattern identification and design method in the garment industry. By combining computer vision technology with neural networks, more intelligent and efficient garment design tools and systems can be developed, providing better support for designers. This will help improve the intelligence level and technological content of the entire industry.

Highlight points:

(a) This study applies the IST method based on BPNN to pattern identification in garment CAD systems, achieving intelligent pattern identification and design.

(b) This study proposes a novel garment CAD system solution based on computer vision and neural networks, which comprehensively utilizes technologies such as DL, neural networks, and computer vision to improve the intelligence level of garment design.

(c) This scheme introduces an attention mechanism to make the model pay more attention to important pattern regions and improve the accuracy of identification.

(d) A garment pattern identification method based on an adaptive threshold, which can automatically adjust the threshold according to the complexity of the pattern and background noise, was proposed in the study.

The main structure of this article is as follows: Firstly, a BPNN-based IST method is proposed and applied to pattern identification in garment CAD systems. Secondly, the effectiveness of this method was verified through experiments, proving that it can improve the effectiveness of pattern identification. Finally, the application prospects of this method in garment design were discussed, providing useful references for future research.

2 THEORETICAL BASIS

In the field of fashion design, clothing design training and computer-aided clothing development have become important research directions. Kassah et al. [7] focused on the performance of clothing design training based on computer vision and neural networks, as well as computer-aided clothing development. By combining advanced computer vision and neural network technology, we can provide designers with more efficient and accurate design training while also achieving intelligence and automation in computer-aided clothing development. It introduces the basic principles of computer vision and neural networks and then elaborates in detail on the process of clothing design training and computer-aided clothing development based on computer vision and neural networks.

The feasibility of this method is verified through experiments. Clothing design training based on computer vision and neural networks can also optimize the design process through automation technology. By automatically recognizing and processing elements and features in clothing images, style design and layout can be quickly completed.

Kovacs et al. [8] explored a clothing graphic design asset recognition method based on computer vision and neural networks. By combining computer vision technology and neural network technology, we propose an effective method for identifying clothing graphic design assets, which can accurately identify and classify clothing design elements. Firstly, the basic principles of computer vision and neural networks were introduced. Then, the design and implementation process of a clothing graphic design asset recognition method based on computer vision and neural networks were elaborated in detail. Clothing graphics in the clothing design field involve a large number of design elements and assets. How to effectively manage and identify these design elements and assets design efficiency and quality. The traditional method of identifying clothing graphic design assets usually relies on manual operation and experience, which has problems such as low efficiency and easy error. Computer vision is a method of simulating the human visual system using computers, which process and analyze visual information such as images and videos to achieve functions such as recognition, tracking, and measurement of target objects. These features can effectively describe the attributes and features of clothing design elements. Fashion design is a field full of creativity and personalization, and graphic sketches are an important means for designers to express their creativity and design concepts. However, the traditional fashion graphic sketch relies on the designer's manual drawing and adjustment, which has problems such as low efficiency and prone to error. To address these issues, Lee and Kim [9] proposed a feature-based approach for fashion plane sketch design using modular automatic alignment algorithms. It explores the application of the module's automatic alignment algorithm in feature-based fashion graphic sketch design. By introducing module automatic alignment algorithms, we can achieve automated design and alignment of fashion plane sketches, improving design efficiency and accuracy. It introduces the basic principles of feature extraction and module automatic alignment algorithms. Then, the design and implementation process of feature-based fashion graphic sketch design using the module's automatic alignment algorithm was elaborated in detail. Finally, the effectiveness and feasibility of this method were verified through experiments. Feature extraction is an important part of fashion graphic sketch design. By extracting features from sketches, we can obtain key information such as their shape, colour, and texture. These features can effectively describe the attributes and style of fashion design. The module automatic alignment algorithm is a machine learning-based algorithm that can achieve automatic alignment and classification of input data by learning and training a large amount of data. In fashion graphic sketch design, we can apply module automatic alignment algorithms to extract and classify features such as shape, colour, and texture of sketches, thereby achieving automated design and alignment of sketches.

The clothing CAD system is clothing design and manufacturing, and its intelligent pattern recognition function can automatically recognize and process various clothing styles and images. However, for complex clothing CAD systems, accurately and quickly identifying and processing large amounts of image data is a challenging problem. Algorithm with powerful image processing and classification capabilities, which can be applied to the intelligent pattern recognition function of clothing CAD systems. Lin et al. [10] explored how to use convolutional neural networks (CNNs) to classify the intelligent pattern recognition kernel images of clothing CAD systems. By analyzing the advantages and applicability of CNN in image classification tasks, a CNN-based image classification method is proposed, and its implementation process and results are detailed. Through experimental verification from a certain brand's clothing CAD system, we found that the CNN-based image classification method has high accuracy and efficiency in the intelligent pattern recognition function of the clothing CAD system. Liu and Yang [11] discussed the contemporary art computer-assisted fashion design model with creativity as its core. By analyzing the importance of creativity in clothing design, this paper elaborates on the role and advantages of computer-aided design in creative expression and provides a detailed introduction to the implementation process, and precautions of the computer-aided fashion design model centred on creativity. Computer-aided design has become an important tool in the field of fashion design. It can help designers express their creativity quickly and accurately, improving design efficiency and quality. This article will explore the contemporary art computer-assisted fashion design model with creativity as the core in order to stimulate the creativity and innovative thinking of designers. Creativity is the core of clothing design, which can provide designers with unique perspectives and inspiration, making design works have unique personalities and styles. In clothing design, creativity is reflected not only in styles, colours, fabrics, etc. but also in design concepts, cultural connotations, etc. Therefore, creativity is an important driving force for the development of clothing design. Computer-aided design can help designers express their creativity quickly. Through professional design software, designers can easily sketch, adjust colours, select fabrics, and quickly convert creativity into visual design works.

Traditional clothing design methods often suffer from errors and human interference, while clothing CAD system design skills based on computer vision and neural networks can reduce errors and human interference and improve design accuracy through automatic recognition and processing functions. The use of computer vision and neural network-based clothing CAD system design skills provides designers with more efficient and accurate design tools and methods. McKinney and Dong [12] focus on evaluating the use of computer vision and neural network-based clothing CAD system design skills. Thereby achieving functions such as automated design and layout. The design skills of clothing CAD systems based on computer vision and neural networks can greatly improve the efficiency of design through functions such as automated design and layout. Designers can quickly recognize and process clothing images through this skill, thereby achieving rapid design and layout, shortening the design cycle, and reducing repetitive labour. Panneerselvam and Prakash [13] studied the application algorithm of computer-aided jacquard pattern design in float control weaving for fabrics with different patterns. By combining computer-aided design and float-control weaving technology, a new algorithm has been proposed to achieve the precise design and efficient float-control weaving of fabrics with different patterns. Firstly, the basic principles of computer-aided jacquard pattern design and float-control weaving technology were introduced. Then, the computer-aided Jacobard design process based on this algorithm was elaborated on in detail, and finally, the effectiveness and feasibility of the algorithm were verified through experiments. Jacquard fabric is a type of textile with unique textures and patterns, widely used in fields such as clothing and household goods. It can achieve accurate simulation and analysis of fabric structure and performance through the mathematical description of fabric texture and pattern.

Sun et al. [14] proposed a RGB-D clothing image recognition. This algorithm combines the depth information of RGB-D images and achieves high-precision pattern recognition through multi-scale feature fusion. Traditional pattern recognition methods often rely on specific gesture actions and backgrounds, while pattern recognition methods can effectively remove the background through depth information. For the depth map of the hand area, a multi-scale feature fusion method is adopted to extract the texture, shape and other features of the hand. By fusing features of different scales, the accuracy and robustness of clothing pattern recognition can be effectively improved. Clothing image classification has become an important research direction. Traditional clothing image classification methods often rely on manually designed features and classifiers, while deep learning-based clothing. However, traditional Xception models still have some problems when processing clothing images, such as insufficient feature extraction and low classification accuracy [15]. Finally, the effectiveness and feasibility of the algorithm are verified through experiments. Introducing attention mechanisms and adjusting parameter settings can further improve the performance and generalization ability of the model. Compared with the traditional Xception model, which has better performance and higher application value.

3 METHODOLOGY

3.1 IST Based on BPNN

IST stands as a technique that transfers the style of one image onto another, yielding an output image that preserves both the essence of the original image and the aesthetic of the desired style.

This technology heavily relies on advancements in DL and neural networks. At present, many methods for IST have been proposed, such as iterative optimization-based methods, DL-based methods, etc. These methods each have their own advantages and disadvantages and need to be selected based on specific application scenarios and requirements.

BPNN that undergoes training through the backpropagation algorithm, as mentioned in. Its primary attribute is its capability to automatically extract features from input data through a learning process, enabling it to handle tasks such as classification or regression. Within the realm of IST, BPNN demonstrates its utility in extracting features from both the original image and the target style, ultimately generating images imbued with the desired target style. The training methodology of BPNN is divided into two distinct phases: forward propagation and backward propagation. During the forward propagation phase, input data is fed into the network and undergoes processing through multiple layers, ultimately yielding an output. In contrast, the backward propagation phase involves computing the gradients of the parameters within each layer based on the discrepancy between the produced output and the ground truth label, subsequently updating the parameter values. This iterative process, when continuously executed, allows the network to enhance its ability to discern features within the input data.

The garment CAD system is used for garment design, pattern making, grading, and layout work. It can help designers design garments more efficiently and improve production efficiency and product quality. At present, there are many types of garment CAD systems on the market, such as AutoCAD, CorelDRAW, etc. These systems typically have functions such as graphic drawing, editing, measurement, and output, which can meet the basic needs of designers. However, existing garment CAD systems still have some shortcomings in pattern identification and design. Involves the acquisition, processing, analysis, and understanding of images. The research work of this article still requires the use of some related technologies and tools, such as DL framework, image processing libraries, etc. These technologies and tools can help us conduct experiments and research more efficiently. Specifically, this study will use Python programming language and TensorFlowDL framework to implement the construction and training of neural networks. Meanwhile, the OpenCV image processing library will also be used for image processing and analysis. BPNN is a neural network with strong learning ability, trained through a backpropagation algorithm, which can automatically extract features from input data and perform tasks such as classification or regression. Within the context of IST, it ultimately generates images that embody the desired target style. In our investigation, we resorted to using a pre-trained CNN to facilitate the extraction of features from the original image and the target style, as documented. Typically, such a CNN architecture encompasses what collectively serves to extract high-level semantic information embedded within images efficiently. Then, the extracted features are fed into a generative network. This network consists of multiple deconvolution layers, which can map features back to the image space and generate images with the target style.

Evidence theory provides a powerful framework for decision-making, especially when dealing with uncertainty and incomplete information. One of its main limitations in practical applications is the acquisition of basic probability allocation. This allocation typically requires a large amount of data and prior knowledge. This study first uses neural networks to process raw input data and extract probability information about category attribution from it. These probabilities can be regarded as the fundamental probability allocation within the framework of evidence theory. Once these basic probability distributions are established, the synthesis rules of evidence theory can be used to integrate different information sources and make the final decision. This integration strategy utilizes not only the powerful learning ability of neural networks to obtain basic probability assignments automatically but also the effective mechanisms of evidence theory to merge and process uncertain information. The specific block diagram is shown in Figure 1.

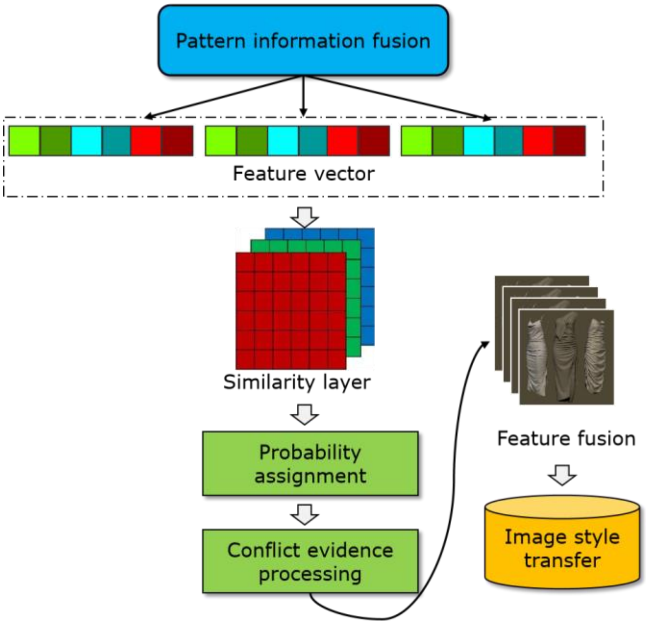

Figure 1: Block diagram of recognizer combining neural network and evidence theory.

Within the realm of evidence theory, functions such as the basic probability assignment, the trust function, and the plausibility function are commonly employed to characterize and manage uncertainties inherent in information. The identification framework, in this context, is conceptualized as a comprehensive set encompassing mutually exclusive events. Consequently, the outcome is an ensemble of all conceivable values, customarily denoted as U. Given this framework, a function $m : 2^U \to [0,1]$ fulfills a set of prerequisites, which are as follows:

$$m(\varphi) = 0 \tag{1}$$

The trust function $BEL(A)$ indicates the degree of trust in the proposition A, which is defined as:

$$BEL(A) = \sum\nolimits_{B \subset A} mB \tag{2}$$

It is the sum of probability measures of all subsets of A, that is, the total reliability of A.

The similarity coefficient serves as a metric to gauge the degree of resemblance among evidence. A higher value indicates a greater level of similarity. The extent of corroboration between evidences can be expressed as follows:

$$Sup(m_i) = \sum\nolimits_{j=1}^{n} d_{ij} \quad (i, j = 1, 2, ..., n) \tag{3}$$

$Sup(m_i)$ Indicates the degree to which evidence E_i is supported by other evidence. By normalizing the support degree of evidence E_i, the credibility value of evidence E_i can be obtained.

The credibility of m_i is:

$$Crd(m_i) = \frac{\sup(m_i)}{\sum\nolimits_{i=1}^{n} \sup(m_i)} \quad (i, j = 1, 2, ..., n) \tag{4}$$

The credibility $Crd(m_i)$ can reflect the credibility of evidence E_i.

3.2 Intelligent Pattern Identification in Garment CAD System

The garment CAD system is a type of CAD software used for garment design, pattern making, grading, and layout work. However, existing garment CAD systems still have some problems and shortcomings in pattern identification and design. This article uses a CNN-based model for the automatic identification and processing of garment patterns. Firstly, we preprocess the input garment image, such as denoising, enhancement, etc., which can effectively recognize different textures and shapes in the image. Next, use a classifier to classify and recognize these features.

In the process of colour image enhancement, directly processing the red, green, and blue primary colours may lead to inconsistency. This colour distortion may affect the visual effect of the image, especially in applications with high requirements for colours, such as garment patterns. We maintain the proportion between the three RGB channels unchanged and enhance the image by adjusting the overall brightness and contrast. This method can ensure that while enhancing the image, it does not disrupt the colour balance and colour relationships in the original image.

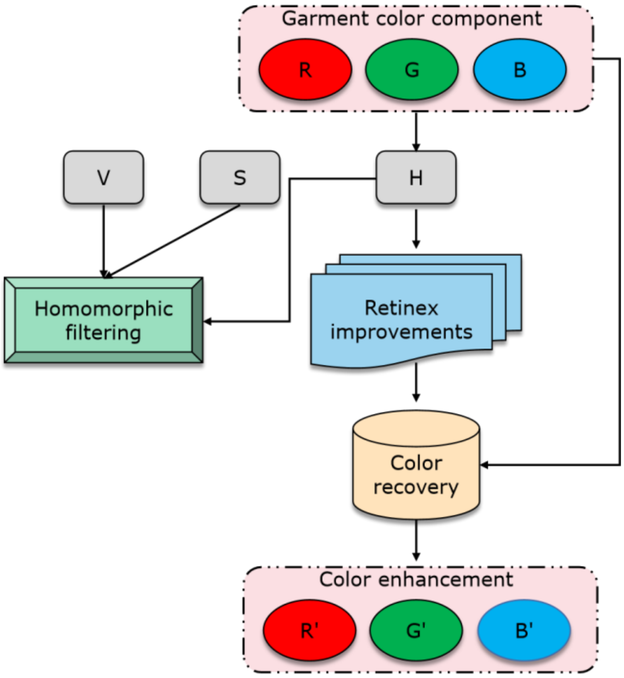

Figure 2: Image color enhancement algorithm process.

When the (H,S,V) value is given, the corresponding (R,G,B) primary colours are:

$$(R,G,B) = (R'+\lambda, G'+\lambda, B'+\lambda) \tag{5}$$

Among them, $\lambda = V - C$.

During the computation of homomorphic filtering, the magnitude of the homomorphic filtering function, denoted as $H(u,t)$, exerts a direct influence on the precision of the final transformation calculations. By taking into account the attributes of the homomorphic filter function, we have devised a Butterworth homomorphic filter tailored to this specific application:

$$H(u,t) = (\gamma_H - \gamma_L)\left[\frac{1}{1+\sqrt{D_o / D(u,t)^{2\pi}}}\right] + \gamma_L \tag{6}$$

Multi-scale refers to a set of diverse Gaussian function parameters, denoted as c, which vary in their values. The cumulative brightness, derived from weighting these distinct scales, can be outputted through the application of the multi-scale Retinex algorithm. This algorithm enables the computation of the sum of the varied reflected brightness levels obtained from the different scales considered:

$$R_{MSR,i} = \sum_{n=1}^{N} w_n R_{n,i} \tag{7}$$

In the feature extraction stage, the original image is input into a pre-trained CNN model, and high-level semantic features in the image are extracted through a series of convolution, pooling, and activation operations. These features can capture key information, such as texture, shape, colour, etc. in the image. After the feature extraction was completed, this study adopted a specific fusion strategy to fuse the features of different images. Due to the fact that the features of different images may exist at different scales and spaces, feature alignment is necessary to ensure that they are fused at the same scale. Based on the aligned features, fusion strategies such as weighted averaging, stitching, and convolution were adopted to fuse the features of different images. After the feature fusion is completed, the fused features are reconstructed into a new image through operations such as deconvolution. The information fusion algorithm model in this article is shown in Figure 3.

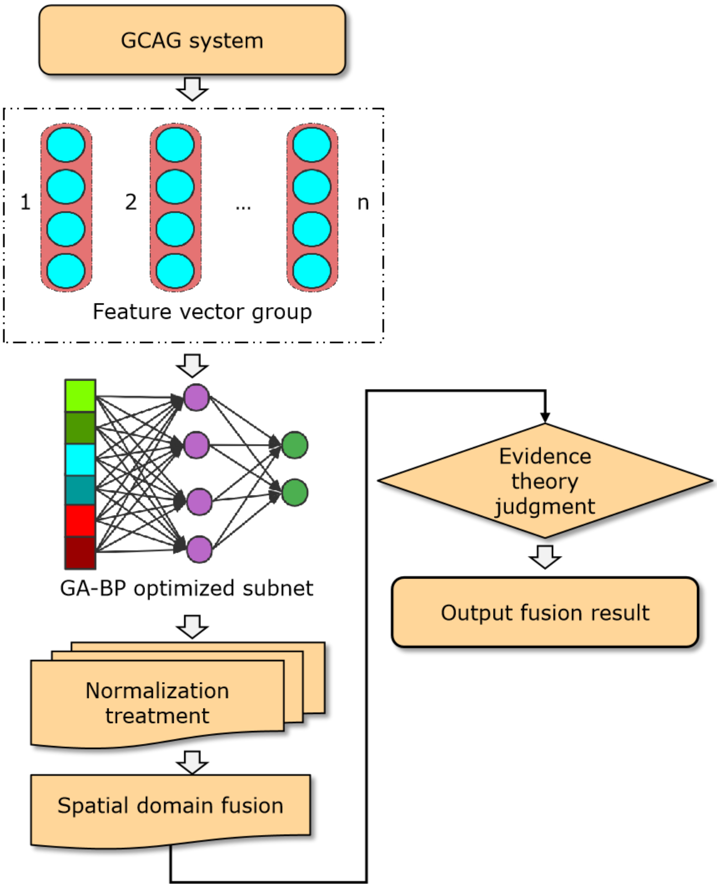

Figure 3: Information fusion algorithm model.

Let's represent the abscissa of two different reference frame nodes and the ordinate of two different reference frame nodes, respectively. In the case that the above index parameter values are correspondingly matched to node (x_1, y_1) and node (x_2, y_2), the resolution estimation result of the three-dimensional digital image can be expressed as:

$$R = \frac{\beta^2 \hat{p}}{\sqrt{e_2(x_2 y_2)} - \sqrt{e_1(x_1 y_1)}} \tag{8}$$

e_1, e_2 Is two different discriminant coefficients of 3D nodes, β is the imaging condition of the reconstructed garment design, and $\hat{p}$ is the imaging feature value of the garment design.

$$N = A \times B \times C \times n \tag{9}$$

When we use a camera to capture CAD models, the camera also has its own coordinate system. This coordinate system is usually related to the physical position and direction of the camera. In the coordinate system of a camera, each point also has corresponding coordinates. When we consider rotating from the camera's coordinate axis to the camera's coordinates, we need to use a rotation matrix. This matrix describes how to rotate the camera's coordinate system to the camera's coordinate system. The projection matrix is used to project points in three-dimensional space onto a two-dimensional image plane. When shooting a CAD model with a camera, the projection matrix describes how to project the coordinates of the 3D CAD model onto the 2D image plane. In addition to rotation, translation may also be necessary to adjust the position of the CAD model to align with the camera. The translation matrix describes how to translate the camera's coordinate system to the camera's coordinate system. Through the above steps, we can align and match the CAD model of clothing design with the actual captured images, thereby achieving precise design verification, adjustment, and optimization.

It $I_1(x, y)$ is the gray value of the image to be registered at the point (x, y) and $I_2(x, y)$ is the gray value of the reference image at the point (x, y), the registration transformation relation between the two images can be expressed by the following formula:

$$I_2(x, y) = g(I_1(f(x, y))) \tag{10}$$

The task of registration is to find the best space geometric transformation function f and gray transformation function g, and the purpose of image registration is to solve the best coordinates and gray transformation parameters.

4 RESULT ANALYSIS AND DISCUSSION

Figure 4 shows the composite image obtained using a model-based iterative IST method. The style-transformed image presents a perfect combination of image content and style. The style-converted image successfully incorporates elements of the target style while retaining the original image content. The main body and details in the original image were well preserved during the style transfer process.

Figure 4: Style transfer.

The kurtosis distribution of coefficients obtained from the basis function response of different types of images and printing patterns was tested in the experiment (Figure 5). The printing and dyeing pattern basis function is a specific function designed for printing and dyeing works used to extract and represent the features of such patterns. Therefore, when the test image belongs to the same style as the printing and dyeing pattern, its response to the basis function should be stronger and more consistent, resulting in a larger kurtosis value of the obtained coefficients. In the experimental results, the printing and dyeing type of garment patterns did indeed achieve the highest kurtosis value, indicating that the basis function successfully captured the intrinsic characteristics of this type of pattern with a strong and consistent response. For other types of test images, the kurtosis values are lower than those obtained from printing and dyeing test images. These images do not belong to the same style as the printed and dyed patterns, or in other words, their features differ significantly from those of the printed and dyed patterns.

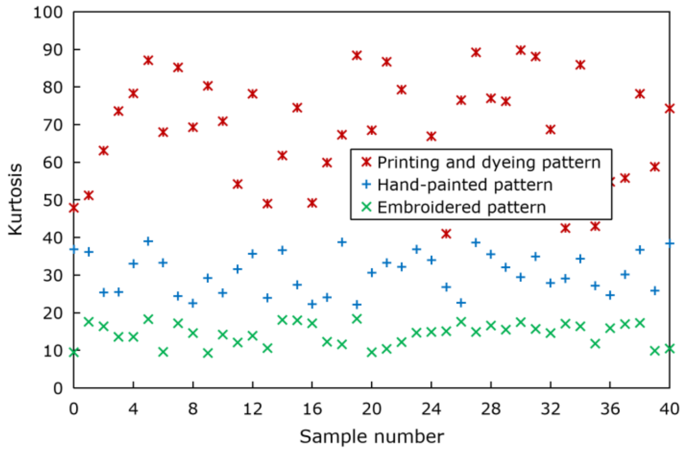

Figure 5: Kurtosis distribution map.

According to the display in Figures 6 and 7, the algorithm proposed in this article significantly outperforms traditional methods in terms of recall and accuracy in garment pattern feature identification.

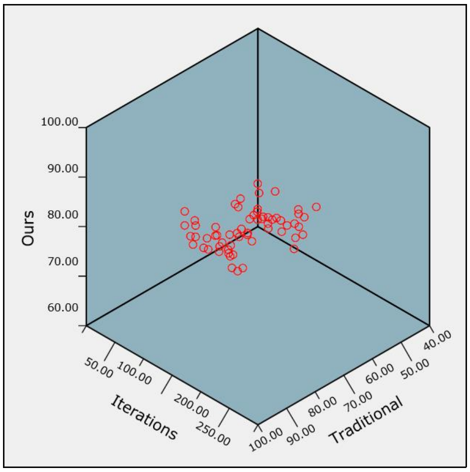

Figure 6: Recall rate of garment pattern feature identification.

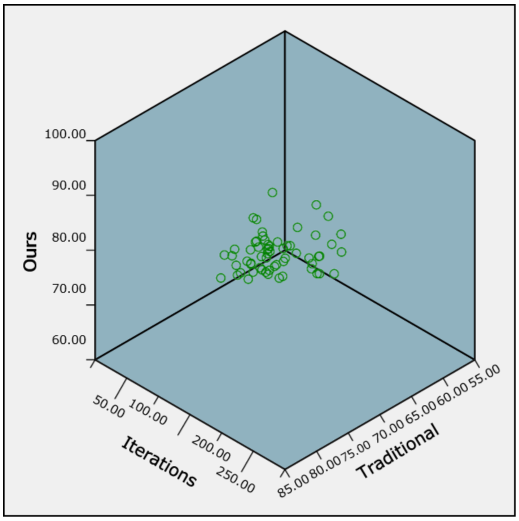

Figure 7: Accuracy of garment pattern feature identification.

From the perspective of recall, the algorithm proposed in this article can automatically extract high-level semantic features from images, which contain key information such as shape, texture, and colour, providing rich clues for pattern identification. From the perspective of accuracy, this algorithm achieves automatic identification and processing of garment patterns by introducing IST and BPNN technology. These technologies can match and fuse the input image with the target style, generating patterns with the target style thereby improving identification accuracy.

Spatial frequency is an indicator that measures the degree of spatial variation of an image, usually used to evaluate the quality of compressed images. In this experiment, some 48 were selected × 48 sized image blocks were blurred using Gaussian functions with different blur radii. By measuring the spatial frequency, visibility, and edge features of these image blocks, it was found that as the blurring degree of the image blocks increased, the values of these three features showed a gradually decreasing trend, as shown in Table 1.

Image number	Spatial frequency	Visibility	Edge features
1	13.669	0.0074	222
2	12.785	0.0074	223
3	8.469	0.0073	211
4	7.808	0.0071	199
5	6.581	0.0068	182

Table 1: Feature quantities corresponding to image blocks.

The three feature values obtained from similar experiments conducted on the selected image blocks are listed in Table 2. Observing the data, it can be observed that the higher the clarity of image blocks, the larger their feature values correspondingly.

Image number	*Spatial frequency*	*Visibility*	*Edge features*
1	15.791	0.0088	259
2	13.987	0.0082	251

3	10.925	0.0078	244
4	9.123	0.0081	241
5	8.838	0.0078	235

Table 2: Image block feature quantity.

Spatial frequency is an important indicator for measuring the degree of spatial variation of an image. In image processing, it is often used to evaluate the quality of compressed images, helping us determine whether the image has lost too much detail and information. The experiment selected a series of 48 × 48 sized image blocks that were blurred using Gaussian functions with different blur radii. As the blurriness of the image blocks increases, the values of these three features show a gradually decreasing trend. This indicates that blur processing leads to a decrease in the degree of spatial variation of the image, and the details and information of the image are gradually smoothed and lost.

Analyzing 48 × 48 48-sized image blocks were subjected to varying degrees of blur processing, and the trends in spatial frequency, visibility, and edge features were measured. It was found that blur processing led to a gradual decrease in these important image feature values. This discovery has important guiding significance for optimizing image processing algorithms, improving image quality, and protecting image information. In future research, further exploration can be conducted on how to better preserve these key features during blur processing to improve the effectiveness and quality of image processing.

5 CONCLUSIONS

The garment industry is a fiercely competitive market, and in order to stand out in the competition, designers need to constantly innovate and design more attractive garments. At present, most CAD systems can only achieve simple graphic drawing and editing functions and are often powerless for complex pattern identification and design. Pattern identification and design remain challenging issues in garment CAD systems. This study proposes a novel garment CAD system solution based on computer vision and neural networks, which comprehensively utilizes technologies such as DL, neural networks, and computer vision to improve the intelligence level of garment design. This algorithm achieves automatic identification and processing of garment patterns by introducing IST and BPNN technology. These technologies can match and fuse the input image with the target style, generating patterns with the target style, thereby improving the recall and accuracy of identification.

Analyzing 48 × 48 48-sized image blocks were subjected to Gaussian blur processing, and the trends of these three feature values were systematically measured. It was found that as the degree of blur increased, the values of spatial frequency, visibility, and edge features showed a gradually decreasing trend. This conclusion emphasizes the impact of blur processing on image quality and information content. Fuzzy processing can lead to the loss of image details, a decrease in contrast, and blurring and diffusion of edge information. Therefore, when performing image processing, it is necessary to carefully choose the degree and method of blur processing to avoid irreversible damage to image quality and key information.

Caijun Wang, https://orcid.org/0009-0005-7318-9080
Weixin Lin, https://orcid.org/0009-0006-4027-426X

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