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Environmental protection clothing design and materials based on green design concept

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This paper explores the integration of eco-friendly materials in clothing design to maintain high-quality and aesthetically pleasing interior clothing design. Texture, as a fundamental element in images, reveals surface characteristics and aids in visual interpretation. The paper introduces an enhanced DCNN-based algorithm for extracting texture features from clothing materials. The algorithm addresses the limitation of moment invariants by combining them with boundary direction characteristics, enhancing its ability to capture shape and spatial distribution information across the entire image. Experimental results validate the algorithm's effectiveness in image analysis and the extraction of apparel material texture features. Applying environmental design principles to the apparel design domain, this study offers a novel perspective on sustainable clothing design. Overall, the paper emphasizes the importance of using eco-friendly materials in clothing design for a better future.

KEYWORDS

green design concept, environmental protection materials, clothing design, textural features, environmental design

1 Introduction

Clothing is crucial for expressing thoughts, emotions, and personal style. The concept of green development has sparked increased attention to environmental protection in clothing design. Green design, rooted in nature, aims to prevent pollution, maintain ecological balance, and foster sustainable harmony between humans and nature (Ding et al., 2016). In the clothing design field, embracing eco-friendly principles will be the future trend (Jin et al., 2018). Leveraging advanced environmental materials and technology can facilitate environmentally conscious clothing design, promoting ecological wellbeing and ensuring that designed clothing integrates technology while upholding environmental harmony (Morrison et al., 2018).

Computer vision, simulating human visual tasks with computers, has gained prominence with the rise of artificial intelligence. It is a pivotal technology driving economic and social progress, labor efficiency, and industry innovation (Chen et al., 2022). Texture, an inherent attribute of object surfaces, provides essential visual cues for image analysis (KimTakatera et al., 2015). In environmental material recognition for clothing, image segmentation isolates material patterns within clothing images. Subsequently, feature extraction from these patterns helps recognize the aesthetic value of environmentally friendly materials in clothing design (Yang et al., 2022).

In the 21st century, the slogan "sustainable development" has echoed resoundingly. To ensure our survival and progress, the design community champions "green design." This approach emphasizes resource conservation, environmental protection, and natural ecology preservation, prioritizing resource optimization, human wellbeing, and eco-friendliness. Green design is the inevitable path for clothing design (Chen and Wu, 2012).

This study focuses on green fabrics, a rising trend in the textile industry that emphasizes low environmental and health impact throughout their lifecycle, from production to disposal. As the global demand for sustainable practices intensifies, the textile industry faces an imperative to adopt more eco-friendly production methods. Green fabrics, characterized by the sourcing of materials, production processes, and ecological footprint, provide diverse options for reducing resource consumption and pollution emissions in the textile sector. Variations among green fabrics, such as performance and cost differences, offer choices for consumers and industry stakeholders.

By conducting comprehensive research on these distinctions among green fabrics, it is anticipated that their pros and cons will be better understood, offering guidance for the textile industry's sustainable development. This thesis will delve into this area and provide valuable insights and recommendations for the adoption and promotion of green fabrics, along with their comparison to traditional fabrics.

The challenge of achieving high-quality performance and aesthetic appeal in clothing design while using eco-friendly materials is a pressing concern in the interior clothing design industry. Constructing an effective method for capturing material texture features, a crucial aspect of material texture recognition, is essential (Park et al., 2018). Designers adopting the green design concept should consider not only the environmental impact of raw materials and manufacturing processes but also the fundamental functionality of clothing and aesthetic preferences (Geng et al., 2018). Images serve as the foundation for human vision and information perception, making color image feature extraction more complex than grayscale counterparts (Wu et al., 2022). This paper explores the application of eco-friendly materials in clothing design under the green design concept, introduces a texture feature extraction algorithm for clothing materials based on an enhanced DCNN, and examines the visual representation of eco-friendly materials in clothing design.

Nowadays, in the process of clothing product development, designers have not paid due attention to the basic functional attributes of clothing, such as the environmental protection of clothing raw materials and the recycling of clothing after a certain period of use. Texture is an inherent attribute of the surface perceived by human visual system (Xu et al., 2016). The surface of each object shows its unique texture characteristics, and this difference constitutes a colorful world (Tjnns et al., 2015). Because the basic data based on text does not contain the visual characteristics of the image, it is difficult for these descriptive keywords to fully reflect the visual characteristics of the image, especially for some features in the image such as texture and shape (Xiong et al., 2015). Flexible, efficient and accurate image retrieval strategy is one of the key technologies to solve these problems. In this paper, a texture feature extraction algorithm of clothing materials based on improved DCNN is proposed, and the visual expression of environmental protection materials in clothing design is discussed. The final model's classification accuracy has increased and the DCNN parameters are converging more quickly thanks to this paper. The technique produces the best possible results for picture feature recognition, and it is more accurate than other feature extraction techniques. In light of this, the DCNN-based texture feature extraction algorithm for apparel materials is a reasonable and practicable feature recognition model that can precisely and effectively extract the texture features of the materials, which is of great significance to the development of apparel materials and the application of the green development concept in the apparel design industry.

The important theoretical significance and potential application prospect of material texture recognition attract many researchers to continue their research and exploration in this field. Puszkarz and Krucinska (2016) think that the ultimate goal of design is not to create much economic benefits, nor to compete in packaging and style, but an element in the process of appropriate social change. Stenton et al. (2021) proposed that multi-scale sampling based on texture images capture texture features and multi-scale counting and differential representation for material texture recognition. The dense micro-block differential method proposed by Pujadas-Hostench et al. (2019) obtains texture features by sampling smaller micro-blocks in the image block and calculating the local structure of the pixel differential coding texture between the micro-blocks. Chen applied RANSAC algorithm to SIFT feature extraction algorithm, which reduced the number of wrong matching point pairs, improved the matching rate, and had stronger characterization ability for clothing patterns of environmental protection materials (Chen, 2019). Mokhtari Yazdi et al. (2016) extracted color features from the color histogram of clothing in RGB color space, and finally analyzed and compared with different similarity measurement algorithms through experiments, and realized clothing image retrieval based on color features. According to the characteristics of environmental protection clothing, Ortaboy et al. (2017) used digital image processing algorithms to identify clothing, and the experiments verified that the HOG feature + SVM classification algorithm achieved good results in the classification and identification of clothing materials. Dai et al. (2018) analyzed the underlying visual characteristics of clothing materials from the perspective of computer vision, deeply analyzed and studied the fuzzy C-means clustering algorithm and its related improved algorithms, and put forward a fuzzy C-means image segmentation algorithm based on spatial domain, which integrated the idea of fast truncation algorithm. Finally, the clothing image segmentation technology was built by mixing Java and Matlab technologies. Demertzi et al. (2017) transformed each color component of a color image by log-polar transformation, expressed the transformed image as quaternion, and carried out quaternion Fourier transformation to extract color texture features. Ayub et al. (2021) extracted the color moments and Gaussian-Markov characteristic parameters of color images, and used the improved simulated annealing algorithm for feature screening and parameter fusion to identify the texture of color materials. Mian et al. (2019) used undirected graph to model color texture in RGB color space, explored the shortest path in different directions in undirected graph, and calculated the first-order statistics of the shortest path in each direction to construct color texture features. Zhi-Bo et al. (2016) extended the color texture on the basis of LBP, and proposed multi-channel decoding local binary pattern to capture material texture features.

The green concept in the design of infant clothing has been researched, and the green design of infant clothing is performed in the aspect of environmentally friendly materials, modeling and colors (Chen, 2012; Andric et al., 2017). Chen and Wu (2012) discuss the green clothing design strategies from the green eco-friendly materials, how to rationalize clothing design. New ecological clothing materials developed in these years cover continuous development and innovation of natural materials and regenerated fiber materials which have been substantially used in modern clothing design and promoted the development of modern clothing design toward the new concept of environmental protection. Property advantages of ecological and regenerated fiber materials will be introduced and its development and application in clothing design will be further illustrated. Liu et al. discuss the important position and function of green packaging materials in packaging design. Based on the analysis of the design connotation and characteristics of green furniture products and the actual level of current green furniture product design at home and abroad, considering the future development trend (Wang and Wang, 2013). Sun et al. focus on the research and puts forward that China's green furniture product design should give priority to the development of green material design technology and humanized design technology, design techniques for cleaning paints and compounds, and design techniques for clean environments (Liu and Pang, 2017). Wang et al. create a healthy indoor space environment that enables people to live in a healthy, safe, comfortable and environmentally friendly living environment (Wang and Wan, 2020). Shih et al. (2021) study research on zero waste garment engineering design in sustainable environment. The concept of environmental sustainability is brought into the clothing project. Chen and Ding (2021) analyze the concept of green clothing design based on computer aided design in ecological era, and puts forward corresponding design strategies. To explore the environmental pollution caused by urban architectural design and construction in the process of urban development, an evaluation model of urban architectural design and construction on environmental pollution was constructed (Fu and Lyu, 2021). However, despite the achievements of past research in the field of environmentally friendly apparel design and materials based on green design concepts, there are still some notable gaps. Previous studies may have failed to explore in-depth in terms of comprehensive analysis, practical case validation, performance of novel eco-friendly materials, design innovation, comprehensive environmental impact assessment, and industrial cooperation. This dissertation aims to fill these gaps, and through comprehensive research methodology and practical validation, in-depth study of environmentally friendly apparel design and materials based on green design concepts, exploring their feasibility, effectiveness and innovativeness at all levels, and providing a more comprehensive guidance and impetus to the development of the sustainable fashion industry.

In the field of eco-friendly apparel design and materials based on green design principles, previous research has made significant progress. However, a critical review of these past efforts reveals important gaps that require further attention. Previous studies often lacked in-depth analysis, practical validation, performance assessment of new eco-friendly materials, design innovation, comprehensive environmental impact evaluation, and meaningful industry collaboration.

This dissertation aims to address these gaps by employing a thorough research methodology, including practical validation, to explore the realm of eco-friendly apparel design and materials guided by green design principles. Our goal is to assess the feasibility, effectiveness, and innovation potential of these concepts at all levels. Through these endeavors, we intend to offer a more comprehensive guide and motivation for the advancement of the sustainable fashion industry.

This thesis focuses on the application of eco-friendly materials in apparel design within the framework of green design principles. Its novelty lies in introducing an enhanced algorithm based on Deep Convolutional Neural Networks (DCNN) for extracting texture features from clothing materials. This algorithm offers an innovative approach to assist designers in selecting and utilizing eco-friendly materials while considering sustainability aspects in apparel design. Consequently, the paper's novelty stems from the integration of deep learning techniques into the domain of eco-friendly material choice and apparel design, advancing the adoption of green design concepts.

The study makes the following advances.

(1) This paper proposes a method of combining improved moment invariants with boundary direction features, which improves the material texture feature recognition and addresses the drawback that moment invariants only focus on the image area and ignore the image boundary.
(2) When getting or showing the texture aspects of garment materials, geometric distortion, gray distortion, and color distortion frequently happen. By positioning and cutting images, this system uses the DCNN algorithm to extract texture features from clothing materials and filters out background interference information.

2 Application of environmental protection materials and material texture feature extraction in clothing design

2.1 Application of environmental protection materials in clothing design

Design behavior itself is an orderly and targeted scientific and rational activity. As the product of the development of the times, green design concept has its unique features and attributes (Cu et al., 2021). The strengthening of social and public awareness of environmental protection and the clear direction of future survival of enterprises are the source of green design development. In green clothing design, designers always use various environmental protection materials to design different shapes of clothing on the basis of keeping the original clothing shape unchanged, reflecting the texture of clothing materials. With the promotion of environmental protection concept, designers pay more attention to the embodiment of natural comfort and green environmental protection concepts while innovating clothing styles. Green fiber materials are widely used in different styles of clothing design, such as leisure clothing design, professional clothing design, sports clothing design, home clothing design and so on. Green clothing design should not only stay in the design concept of clothing, but also apply the connotation embodied in green design to the actual design, so as to obtain the achievements of innovative design.

From the point of view of protecting the ecological environment, green environmental protection clothing takes natural animal and plant materials as raw materials, and avoids using chemical printing and dyeing raw materials and resins to destroy and pollute the environment from raw material production to processing. Natural materials are not only renewable and degradable, but also do not produce harmful substances and have adverse effects on environmental protection and human health (Shen et al., 2019). The design of business attire needs to focus on the requirements of character and work nature, and flexible use of different green fiber materials can better play the role of business attire. The design of sportswear should focus on the comfort and sweat absorption and permeability of the clothing, so as to provide a better temperature regulation environment for physical exercise and ensure good health. The most basic design point of innovative clothing design with green design concept lies in the use of clothing materials, so it is particularly important to choose appropriate clothing materials for design and creation. For modern clothing designers, on the basis of fully understanding the advantages and disadvantages of traditional fabrics, combined with the characteristics of the development of the times, the influence of new fabrics on the environment is designed reasonably, which will better show the importance of green materials to the contemporary ecological environment.

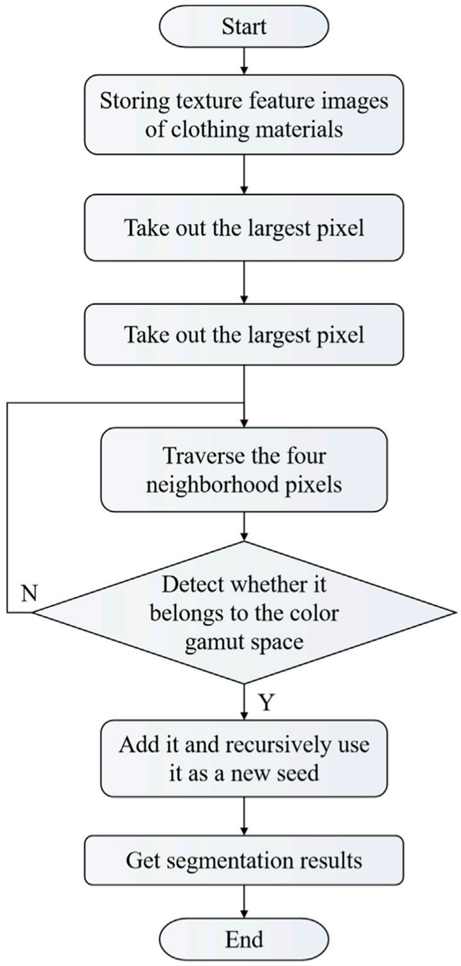

FIGURE 1
Texture feature extraction of clothing materials.

2.2 Texture feature extraction of clothing materials

The RANSAC algorithm is an iterative method for estimating the parameters of a mathematical model, typically used to estimate the optimal model from a data set containing noise and outliers. It was originally proposed by Fischier and Bolles in 1981 and is mainly used in the fields of computer vision and computer graphics.

The core idea of the RANSAC algorithm is to randomly select a small portion of data from a dataset as a sample set and then fit a model based on these samples. After that, those data points that fit the model poorly are labeled as outliers by calculating the distance of other data points to this model. Then, the model parameters are re-estimated based on the well-fitted data points and the above steps are iterated until some predefined stopping condition (e.g., number of iterations, number of outliers, etc.) is reached (Qin, 2018).

Human beings and the environment interact with each other. While human beings are changing the environment, the environment is also affecting human beings. At present, the unplanned and uncontrolled production of clothing enterprises leads to the supply of products exceeding the demand, which leads to a large inventory backlog of enterprises and seriously affects the development of social environment. Facing the current problems, the clothing industry and designers should also respond positively, explore the ways to deal with the overstocked inventory of clothing enterprises and the problems of textile waste produced in production, and promote green sustainable development. Green design has been paid attention to. Texture is an important characteristic existing in natural images, and it is an inherent property of entities or natural scenes, which is characterized by the brightness, color, shape and scale of objects. Image feature is the representation of the same attribute of homogeneous regions in the image, which can be used to calibrate different regions in the image and the main characteristics of the image (Shen et al., 2019). In the process of upgrading and rebuilding old things, it can be used in the design of upgrading and rebuilding old things through the expression of whole or partial design. According to the original form of outdated fabrics and old clothes, we can use manual processing or secondary processing with machinery and equipment to make old clothes materials present a brand-new artistic form, which not only expands its existence value, but also prolongs the life cycle of clothes. Texture image analysis is to extract texture features from images to explain and understand the potential visual patterns and characteristics of images in the real world. One of the main problems of texture image analysis is that there is no uniform law to follow for the texture existing in

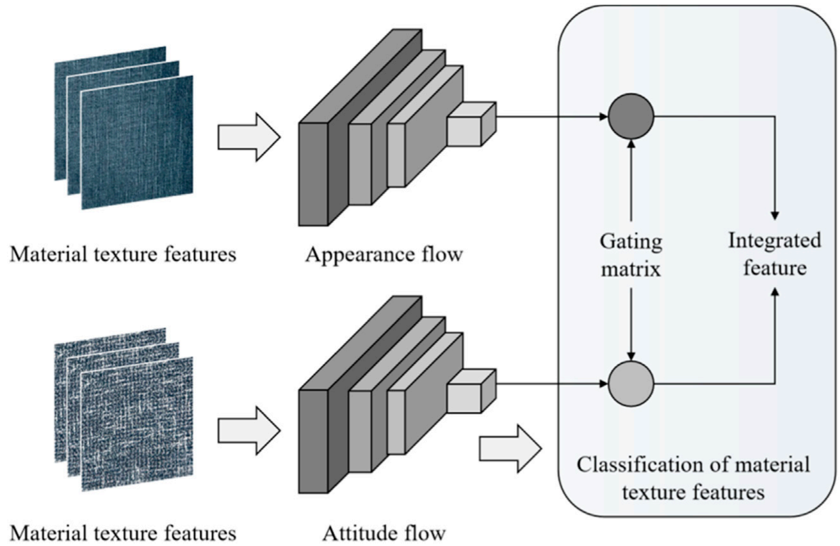

FIGURE 2
Dynamic fusion of texture features of clothing materials.

the real world due to the changes in viewpoint, scale, illumination and visual appearance.

3 Materials and methods

Texture image classification is to minimize the similarity difference between texture images from the same class and maximize the acquaintance difference between images from different classes. It is of great research value and application prospect to study and construct a distinguishable and robust texture feature for material texture recognition. Texture features are important because people's vision feels the contour or shape of the target most accurately. For example, if there are many photos, including several photos of someone wearing different colors and patterns, people's vision will still find out the photos of the person according to their shapes, and they will not mistake people for others. Similarly, when a person is in different complex backgrounds, people's visual system will also make correct judgments according to the clear outline of the target. The image segmentation process of clothing material texture feature extraction is shown in Figure 1.

The material texture feature extraction system in this paper works under the general framework of shape-based material texture feature extraction system. The basic method of shape-based material texture feature extraction is to preprocess a given example image and extract the feature vector of the image (Wang and Wang, 2013). By matching the texture feature vector of the material with the feature vector of each image in the feature library, and returning the recognition results to the user according to the similarity from large to small, the recognition process is completed. The dynamic fusion method of clothing material texture features based on DCNN is shown in Figure 2.

Different from the single-shot amplitude coding method, we don't compare the size relationship of the single-shot phase of the central pixel and its corresponding neighborhood, but compare whether the feature types they represent are the same after further quantization. If the single phase of the central pixel and its corresponding neighborhood is within the same angle range, it is considered that the neighboring pixel and its corresponding central pixel have the same phase direction information. The single amplitude information quantifies the energy of the signal, and the high amplitude value represents the local characteristics of high energy, such as edges, lines and local textures in the image. Combining local binary pattern and single-shot signal filtering, binary pattern features are extracted on the basis of single-shot amplitude information. The convolution neural network function is defined as:

$$x_j^l = f\left(\sum_{i\in M_j} x_i^{l-1} \times k_{ij}^l + b_j^l\right) \tag{1}$$

Where x_i represents the input characteristic map, k represents the convolution kernel, b represents the deviation term, and the convolution output is the characteristic map x_j. Assume that the convolution layer convolves the input clothing material texture image with k filters, and generates k new feature maps for subsequent processing. If the output feature map is represented in a layer, then:

$$F_j^{(n)} = \sum_i w_{ij}^{(n)} * F_i^{(n-1)} + b_j^{(n)} \tag{2}$$

Where: * is a two-dimensional convolution; $w_{ij}^{(n)}$ and $b_j^{(n)}$ are convolution filters and deviations, respectively; $F_j^{(n)}$ is the j output characteristic map at the n layer. The formula of active layer after convolution is as follows:

$$F_j^{(n+1)} = f\left(F_j^n\right) \tag{3}$$

Where: f is a point-by-point activation function. Convert each data item x_i in the small batch $B = \{x_1, x_2, x_3, \ldots, x_m\}$ with size m to y_i:

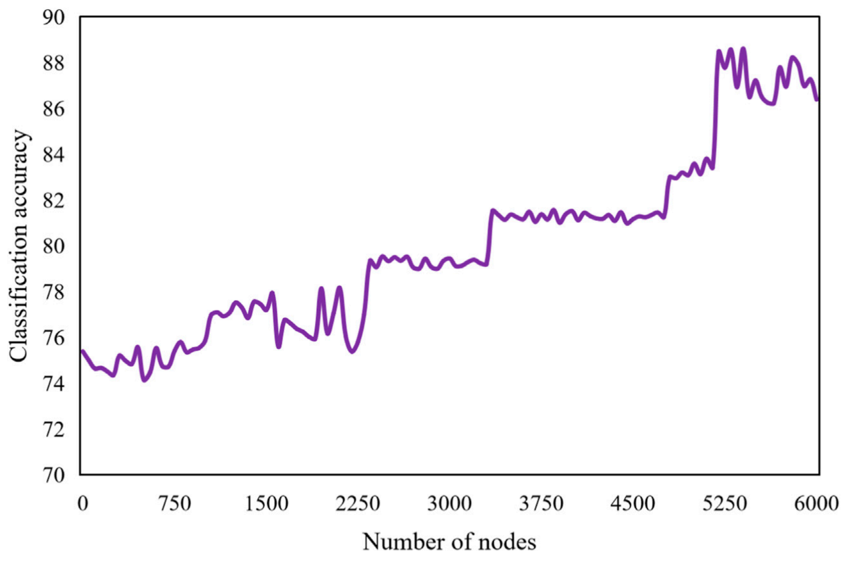

FIGURE 3
DCNN feature extraction accuracy.

$$y_i = \gamma \widehat{x}_i + \beta \tag{4}$$

$$\widehat{x}_i = \frac{x_i - E_M(x_i)}{\sqrt{Var_M(x_i) + \varepsilon}} \tag{5}$$

Where: $E_M(x_i)$ and $Var_M(x_i)$ are the mean and variance, respectively.

For texture mapping technology, it is to map the texture picture in a plane state to the corresponding 3D model. First, use a digital camera to shoot the material of the mapped picture, and then use the digital tool of two-dimensional static processing to process it again, so as to complete the stitching operation and repairing operation of the picture. By making the generator produce the same image features as the actual image, the whole training process can be stabilized. The risk function of the clothing material texture recognition model is as follows:

$$\theta^* = \arg\min_{\theta} \frac{1}{N}\sum_{i=1}^{N} L(y_i, f(x_i;\theta)) + \lambda\Phi(\theta) \tag{6}$$

Among them, the L function represents the loss function; x_i and y_i represent the predicted value and the true value respectively; the f function is the function of the model, and the Φ is the regularization term. The calculation formula of the logarithmic loss function is as follows:

$$L(Y, P(Y \mid X)) = -\log P(Y \mid X) = -\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{M} y_{ij}\log(p_{ij}) \tag{7}$$

Among them, Y is the output variable of the function, X is the input variable of the function, N is the total number of input samples, L is the loss function, and M is the number of possible categories. Obtaining the optimized area of clothing texture image by the method of gray difference:

$$I_{Truth} = \begin{cases} 1 & if I_D \geq s \\ 0 & otherwise \end{cases} \tag{8}$$

Among them, I_D is the absolute difference of the gray value of each pixel of the optimized image and the original image. The loss function of the model training is the weighted cross entropy L_{Mask}, and the calculation method is:

$$L_{Mask} - \frac{1}{C}\sum_{i=0}^{C-1}\left(\alpha \cdot y_i \ln\left(y_i'\right) + \beta \cdot (1 - y_i)\ln\left(1 - y_i'\right)\right) \tag{9}$$

Among them, y_i and y_i' are the real value of each target point in the image area and the predicted value of the model, respectively, and C is the total number of pixels in the received image each time. Under the background of practical application, images are often influenced by some random factors such as position, direction and illumination. In these cases, it is still necessary to ensure the correct classification of texture images, which requires extracting texture features that are invariant to rotation.

4 Result analysis and discussion

Green design and new materials complement each other. On the one hand, the concept of green design promotes the development and birth of new materials. Under the guidance of the concept of green design, combined with high technology, we will develop and utilize new materials that are compatible and coordinated with the ecological environment, tap its more functionality and environmental protection, and purify the ecological environment. The material texture image is expressed as a single amplitude, phase and direction image with complementary information by single signal analysis. Feature maps of local monosyllabic amplitude, phase and direction are extracted from monosyllabic amplitude, phase and direction images, and then the extracted features are expanded by sampling structure, and the three feature maps are divided into multiple rectangular sub-regions. Using digital image processing technology, the sensory information and experience are quantified and systematized as accurately as possible to obtain clear features

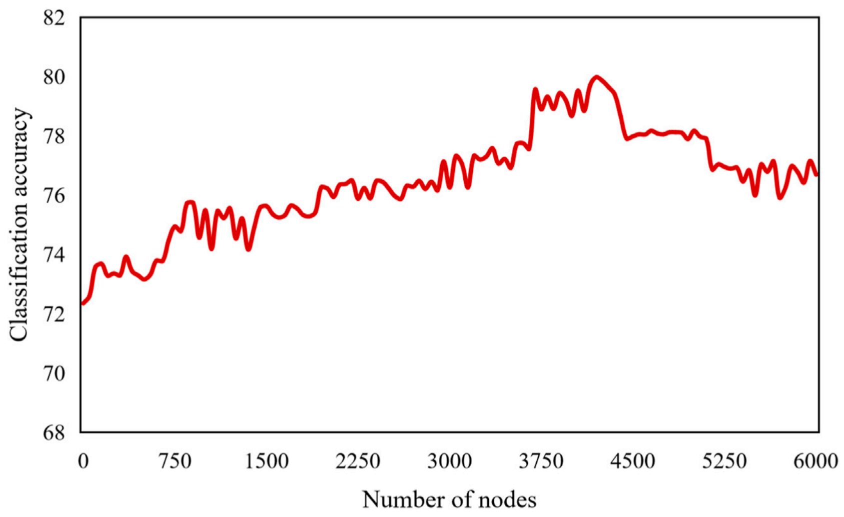

FIGURE 4
AIA feature extraction accuracy.

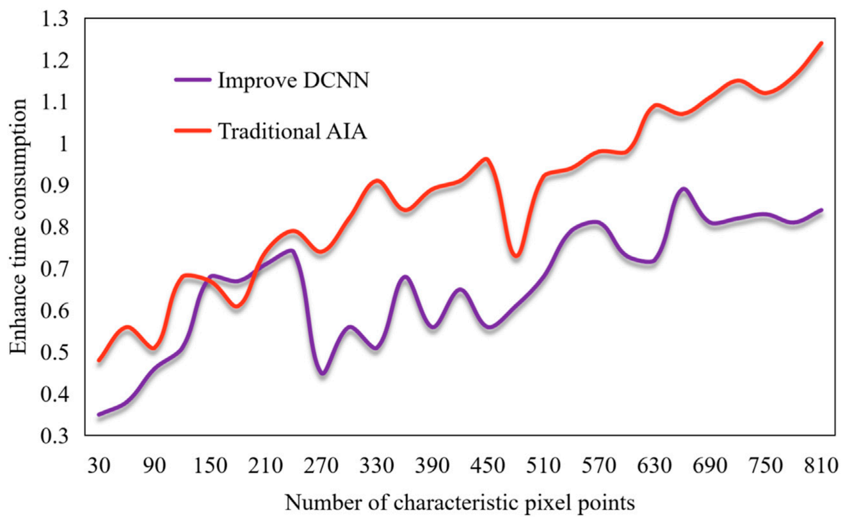

FIGURE 5
The processing effect of material texture features by different methods is time-consuming.

and rules, so as to improve the accuracy and reliability of texture feature extraction of clothing materials.

The test set is used to evaluate the final results of the model, and also verifies the generalization ability of the model, but it will not affect the adjustment of parameters. The training set is used to fit the model and set the parameters of the model, and then combined with the verification set to adjust the parameters, which is also the largest data set. The model obtains image features through continuous iteration and then adjusts parameters. After each iteration, the feedback accuracy of the test set is used to judge the iteration, and the iteration result with the highest accuracy is saved. Spatial saliency is used in each sub-region to weight the feature histograms extracted from the sub-regions, and the weighted feature histograms on all sub-regions are connected together. After feature extraction, each image uniquely corresponds to a feature descriptor, and the differences and similarities between different types of images are quantified by their corresponding features. The feature extraction accuracy of different algorithms in clothing material texture feature extraction is shown in Figures 3, 4.

DCNN is mainly constructed according to the number of layers of neural network, which is a nonlinear mapping, and the transmission path is also a process from low transmission to high transmission. The final conclusion of the model depends on the sample set to some extent. Therefore, the selection of sample sampling technology is very important to successfully establish a suitable clothing material texture feature extraction model.

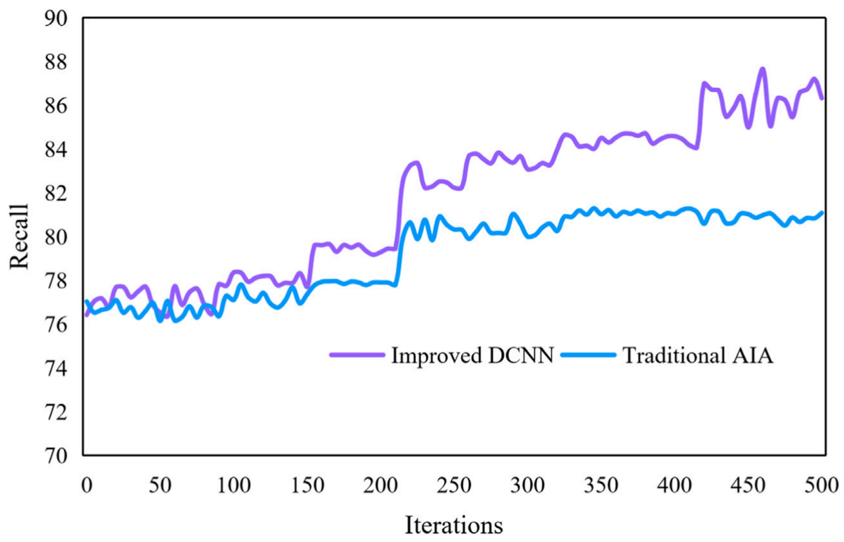

FIGURE 6
Comparison of recall.

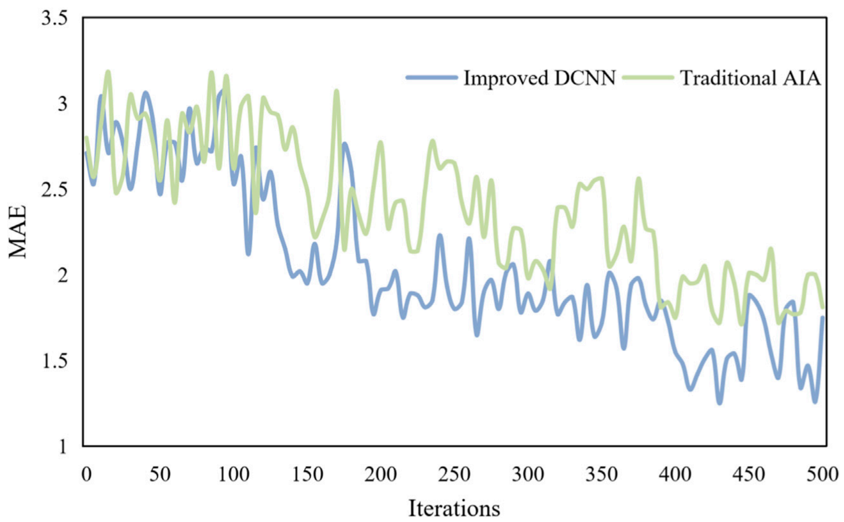

FIGURE 7
Comparison of MAE.

Input all the collected data information into the computer system, and carry out stitching operation, synthesis operation, deformation operation and color correction operation, and deal with the background color part and grain part. After the data information is entered, it enters the image processing, and the color tracking processing is adopted during the output printing, so that the position color extracted from the material texture features can be consistent with the original color. The time-consuming of material texture feature processing with different methods is compared and analyzed, as shown in Figure 5.

As can be seen from Figure 5, the time-consuming of traditional clothing material texture feature processing increases with the increase of the number of feature information pixels, which takes a long time. Although the processing of material texture features based on improved deep convolutional neural network (DCNN) takes some time, it has a significant time advantage and faster processing speed compared with traditional methods.

The change of network is reflected by the change of network connection right, and the change of numerical value is determined by the learning law of processing unit. Comparing the recall and MAE of clothing material texture feature extraction model based on improved DCNN with traditional AIA, the results are shown in Figures 6, 7.

There are many related images in the image, and the images with high similarity rank high in the retrieval output, which can realize good retrieval expectation. As can be seen from Figures 6, 7, after many iterations, the accuracy of the improved DCNN is obviously better than that of the traditional AIA, reaching 96.95%, 16.99% higher than that of AIA, and the error is reduced by 33.66%. MAE refers to Mean Absolute Error, As shown in Figure 7, the improved DCNN feature extraction model has a low MAE value and performs well on multiple data points, implying that the model's predictions have higher stability and reliability. Through the improvement of this paper, the convergence speed of DCNN parameters is faster, and the final model classification accuracy is higher. This method obtains ideal results of image feature recognition, and the recognition accuracy is higher than other feature extraction methods. Therefore, the texture feature extraction algorithm of clothing materials based on DCNN is a reasonable and feasible feature recognition model, which can accurately and effectively extract the texture features of materials, and is of great significance to the innovation of clothing materials and the practice of green development concept in clothing design industry.

5 Conclusion

In the era of high technology, there is a growing emphasis on green and low-carbon clothing design within the fashion industry and society. This approach prioritizes regeneration, alternative cycle design, and manual production processes. By incorporating these principles, it becomes possible to reduce and mitigate secondary pollution from complex industrial processes and the excessive resource wastage, ultimately leading to decreased carbon emissions. This innovative approach offers new ideas for low-carbon and green clothing design.

In the field of clothing design, the green design concept of clothing will be the development trend of future design. Under the premise of advanced environmental protection materials and high technology, we can better promote the green design of clothing and promote the development of environmental ecology to a virtuous circle. This paper studies the application of environmental protection materials in clothing design under the concept of green design, puts forward an improved DCNN-based texture feature extraction algorithm of clothing materials, and discusses the visual expression of environmental protection materials in clothing design. The time-consuming of traditional clothing material texture feature processing increases with the increase of the number of feature pixels, which takes a long time. However, although the time-consuming of material texture feature processing based on improved DCNN is also on the rise, it has obvious advantages and shorter time-consuming compared with traditional methods. After many iterations, the accuracy of the improved DCNN is obviously better than that of the traditional AIA, reaching 96.95%, 16.99% higher than that of AIA, and the error is reduced by 33.66%. Therefore, the algorithm of clothing material texture feature extraction based on DCNN is a reasonable and feasible feature recognition model, which can accurately and effectively extract material texture characteristics. Designers need to constantly learn and master new materials and new technologies, cross the boundaries of disciplines, overcome the limitations of traditional thinking, strive to develop and apply new green materials in clothing design, practice the concept of environmental protection with design works, lead the trend of environmental protection, and promote the sustainable development of textile and garment industry.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Author contributions

CY and XZ contributed to conception and design of the study. CY organized the database. XZ performed the statistical analysis. CY wrote the first draft of the manuscript. CY and XZ wrote sections of the manuscript. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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