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Computer-Aided Design AND APPLICATIONS

CAD Assisted Brand Packaging Image Processing Algorithm in Graphic Design Teaching

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Abstract. Brand packaging design is an important field in graphic design. With the growth of technology, computer aided design (CAD) has become a key tool in the process of brand packaging design. This article aims to explore how to integrate CAD-aided design into brand packaging design in graphic design teaching, improve students' design ability and efficiency, and cultivate innovative thinking and practical ability. Through the design and test of packaging image processing algorithm, the contrast, brightness and color balance of packaging image are adjusted, and the clarity and vividness of the image are improved. Through the design and test of packaging image processing algorithm, the effectiveness and superiority of the algorithm are proved. Simulation results show that this algorithm improves the classification performance and the accuracy of brand pattern integrity detection on the basis of retaining the main information. Moreover, the image processing method of the algorithm takes less time and shows higher running efficiency. This algorithm can not only improve the effect and quality of brand packaging design, but also reduce the design cost and time. In the future, more emerging CAD technologies can be introduced into graphic design teaching to meet the needs of industry development.

Keywords: Graphic Design; CAD; Packaging Design; Image Processing
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1 INTRODUCTION

CAD, as a new course in the new situation, plays a great role in promoting art design teaching, especially graphic design teaching. The background of the era of reading pictures requires designers to come up with design schemes and effects that satisfy customers in a short time. In the past, the painting forms and drawing methods that relied on pure hand have been far behind. Bao et al. [1] analyzed the important role of intelligent algorithms in 3D graphics engine animation design. The 3D graphics engine needs to process a large amount of data and complex calculations, and intelligent algorithms can automate these tasks, improving the efficiency and quality of animation design. Genetic algorithm is an optimization algorithm based on the principle of

biological evolution, which can optimize the shape, material, and other parameters of a 3D model during the generation process, improving the fidelity and performance of the model. Neural networks are a data processing method that simulates the structure of human brain neurons, which can be used for automatic generation and repair of three-dimensional models, improving the quality and efficiency of the models. Reinforcement learning is an algorithm that uses trial and error learning to design and control the behavior of animated characters, achieving more flexible and natural behavior. Machine learning algorithms can learn laws and knowledge from a large amount of data, which can be used to generate and control the actions of animated characters, improving the fidelity and expressiveness of animation. Under the background of the current information society, users' consumption ideas and aesthetics are also changing with each passing day with the acceleration of the pace of life. The function of brand packaging of products is no longer just as the carrier of products, and the functionality of packaging is no longer the primary issue. The function of packaging is more specifically reflected in brand value and brand image, so that consumers can choose the successful brand packaging from a wide range of goods. In the food market, packaging design, as a key carrier of product image and brand image, has a significant impact on consumers' purchasing decisions. Packaging design conveys product information to consumers through elements such as color, graphics, and text, stimulating their purchasing desire. Among them, the application of color plays an important role in packaging design, as it can affect consumers' first impression, stimulate their emotions, and affect their perception of product quality. Therefore, Bou-Mitri et al. [2] aimed to explore the relationship between color elements in food packaging design and consumers' perception of product quality, safety, health, and preferences. Color is an important element in food packaging design, which can affect consumers' first impression of the product, stimulate their emotions, and affect their perception of product quality. In food packaging design, the use of color can directly affect consumers' perception of product quality, safety, health, and preferences. For example, using natural green can convey the health and naturalness of a product, while bright colors can highlight the spiciness or freshness of the product. This causal relationship is a factor that packaging designers must consider in the design process. This design idea and form greatly please consumers' psychology under the background of contemporary society, and coincide with contemporary people's ideological and cultural values, so it has become one of the graphic design expressions sought after by designers. Guo and Wang [3] applied computer-aided modeling design in the expression techniques of sculpture art space. Through computer-aided design, sculptors can better control the appearance and spatial expression of their works, thereby enhancing their artistic value and expressive power. By using 3D modeling software, sculptors can create virtual models of their works. This model allows sculptors to observe and adjust the appearance and spatial relationships of their works more intuitively, including shape, size, texture, etc. Virtual reality technology can allow sculptors to experience the spatial expression of their works in a virtual environment. Through devices such as headsets and handles, sculptors can observe and interact with their works from all angles, thereby better grasping the spatial and three-dimensional sense of the work. Digital carving software allows sculptors to create on a computer, similar to traditional carving processes. Through digital carving tools, sculptors can accurately shape the details and contours of their works, and adjust the depth and shape of carving in real-time. In order to make consumers understand the product characteristics more intuitively and leave a deep impression on the product, and increase consumers' desire to buy, more and more rich means of product packaging design and connotative product packaging design emerge one after another in the market. With the rapid progress of modern computer and intelligent technology, it is needed to apply CAD technology to develop a real packaging CAD system.

Holland et al. [4] use various non-destructive testing techniques (such as ultrasound, radiation, eddy current, etc.) to obtain information about the physical and mechanical properties of the tested object. It collects this information from physical objects using appropriate sensors and devices, and then performs necessary preprocessing and cleaning to ensure the accuracy and consistency of the data. Use statistical and numerical methods to conduct in-depth analysis of data to extract valuable information about object quality, integrity, performance, and other related

attributes. At this stage, based on the data obtained during the analysis phase, a mathematical model is established to describe the performance and quality of the object. This may involve creating physical models or creating predictive models (such as using machine learning algorithms to predict the performance of objects). Verify the accuracy of the model and make adjustments and optimizations as needed. This may involve repeated data analysis, model adjustment, and validation processes. Finally, apply the created model to actual scenarios. This may involve using models for prediction, optimization, control, or other decision support activities. Packaging design should not only reflect product characteristics and brand value, but also be consistent with contemporary people's ideological and cultural values. Plane composition, an art form, conforms to people's consumption concept and psychology under the current social ideology, and this form of expressing beauty is often used to reflect the characteristics and value of products. This design idea greatly adapts to the consumption psychology of contemporary consumers. In the process of contemporary teaching work, computers have become an inseparable and important tool, which brings convenience to teachers, but also constantly enhances the status of informatization in the classroom. Image feature extraction methods are mainly divided into manual feature extraction methods and learning-based feature extraction methods. For more complex images and visual scenes, the expressive ability of manual features is not very strong. In today's fiercely competitive market environment, brands have become a key factor in distinguishing competitors and establishing a unique image. Brand color, as an important component of brand image, has the effect of conveying brand information, shaping brand image, and enhancing brand memory. This study aims to explore the impact of brand color identity on brand association and loyalty, in order to provide theoretical support and practical guidance for product and brand management. Jin et al. [5] aimed to explore the impact of brand color identity on brand association and loyalty. From the perspective of product and brand management, analyze the role of brand color in shaping brand image, conveying brand information, and establishing brand loyalty. The research results indicate that brand color identity has a significant positive impact on brand association and loyalty. Deep learning (DL) method is a feature extraction method based on learning that has developed rapidly in recent years. The biggest difference between DL method and manual feature extraction method is that DL method learns image features from a large number of data by itself rather than based on relevant apriori. This article aims to explore how to effectively use CAD to assist brand packaging design in graphic design teaching, and improve students' design ability and efficiency. In this article, a packaging image processing algorithm based on feature coding and DL is proposed. By extracting and adding features of packaging images, the process of CAD-aided brand packaging design in graphic design teaching is improved.

Environmental art design is a comprehensive discipline that involves spatial planning, interior design, landscape design, and other aspects. With the advancement of technology, computer-aided design (CAD) software has become an indispensable tool in the field of design, playing a significant role in improving design efficiency, optimizing design schemes, and facilitating scheme display. Jin and Yang [6] explored the application of computer-aided design software in environmental art design teaching. CAD software provides rich design tools that can quickly perform various design operations, such as drawing, editing, and modifying graphics. This greatly improves the efficiency of design, allowing students to devote more time and energy to the design itself instead of tedious manual operations. CAD software can generate three-dimensional models, making design works more three-dimensional and intuitive. This three-dimensional display method not only helps students to comprehensively review and adjust design plans, but also facilitates the display and sharing of their design achievements. In terms of existing products, the efficacy is similar, and packaging is an important reason for consumers to buy goods. Because of the difference in efficacy, of course, people will recognize goods with exquisite packaging, so the packaging design of brands is undoubtedly crucial. Using CAD method, the traditional packaging design has undergone great changes, so that designers can greatly break through the limitations of traditional manual operation, update the design more quickly, express the information of the work in many ways, and make it easier for technical ideas and artistic creation to penetrate and communicate with each other. As a design tool, computer is no longer an auxiliary tool, and the

demand for design talents has also changed. The whole process from design to production requires designers to use computers skillfully.

This article studies how to use CAD to assist brand packaging design in graphic design teaching. The research includes the following innovations:

(1) A packaging image processing algorithm based on feature coding and DL is proposed. By extracting and adding features of packaging images, the process of CAD-aided brand packaging design in graphic design teaching is improved.

(2) Three instructional methods, case teaching, practice teaching and reflection teaching, are put forward to cultivate students' practical operation ability and independent thinking ability. These methods can not only improve students' design ability and efficiency, but also promote students' personality development and innovative thinking.

This article first introduces the significance of the application of CAD technology in graphic design teaching; Then, a packaging image processing algorithm is proposed by combining feature coding with DL. Finally, the packaging image processing ability of the algorithm is verified, and the improvement strategy of graphic design instructional method is put forward. Finally, the research contribution is summarized.

2 RELATED WORK

Jing and Song [7] analyzed the application of 3D reality technology and CAD in animation design. 3D reality technology and CAD are playing an increasingly important role in animation design. Computer Aided Design (CAD) is a computer system used to create, modify, analyze, or optimize design objects. And 3D reality technology can present design works in a three-dimensional form, enabling designers and audiences to appreciate and understand design works more intuitively and comprehensively. Using CAD software, designers can easily create 3D models. These models can be obtained based on images, sketches, or actual 3D data, such as scanning or measurement. The created model can be placed in a 3D environment, allowing designers to observe and adjust it in detail before actually creating the animation. In 3D CAD software, designers can add materials and textures to the model, making it visually more realistic. For example, you can add textures to a character's skin to make it look more realistic. Liow et al. [8] discussed the potential of applying machine learning in the fields of art and design. Although these two fields may seem unrelated to technology, as technology advances, machine learning is bringing innovation to these two fields. For example, the work of an artist named Pierre Duchamp is seen by many as one of the first contemporary artworks to showcase the concept of 'ready-made objects'. However, despite his works having a profound impact in the art world, this creative method has not yet been widely applied in the fields of design and architecture. However, with the development of machine learning, this situation is changing. IDEO Lab is using deep learning algorithms to analyze various elements of design projects, such as color, shape, and size, in order to predict market reactions for specific design features. Nike's laboratory is using machine learning to improve the design of sports shoes. The article also discusses the limitations of machine learning. For example, although machine learning can provide predictions of market responses to design features, it cannot guarantee the accuracy of these predictions. In addition, although machine learning can provide in-depth analysis of existing design data, it cannot guarantee that these data can predict future market development.

Chocolate is a popular dessert, and its packaging design has a significant impact on consumers' purchasing decisions. During this process, many researchers have conducted research on the influencing factors of chocolate packaging design and its impact on consumer purchasing intention. Among them, Kansei is a psychological research method based on human perception and emotional feedback, widely used in the field of product packaging design. Maleki et al. [9] aim to explore the impact of Kansei based chocolate packaging design on consumer perception and purchase intention. Specifically, we will investigate the impact of different packaging design elements (such as color, shape, pattern, etc.) on consumers' purchase intention and analyze the

role of consumer perception in it. It will select chocolate products from different brands in the market and collect their packaging design elements. Then, we will collect consumers' purchasing intentions and perceptions of packaging design through a questionnaire survey. In the questionnaire, we will ask consumers to evaluate their preferences for different packaging design elements, as well as the quality, value, and attractiveness of the product. Finally, we will use statistical methods to analyze the data and explore the relationship between packaging design elements, consumer perception, and purchase intention. With the increasing awareness of environmental protection among people, the role of food packaging design in sustainable development is becoming increasingly important. Nemat et al. [10] aim to explore the potential impact of food packaging design attributes on consumer waste classification decisions, and from the perspective of sustainable development, analyze the impact of factors such as sustainability, recyclability, and reusability of packaging on consumer purchasing intentions and disposal options. Food packaging design plays an important role in product marketing, not only protecting the freshness and safety of food, but also influencing consumer purchasing decisions. However, with the increasing awareness of environmental protection, consumers are increasingly concerned about the sustainability and environmental friendliness of food packaging. Therefore, food packaging design needs to consider sustainable development factors to promote consumers' correct garbage classification and recycling. The color, pattern, material and other attributes of food packaging can affect consumers' perception and attitude towards products. At the same time, factors such as sustainability, recyclability, and reusability of packaging also affect consumers' evaluation and purchase intention of products. In addition, consumers are increasingly demanding the environmental friendliness of packaging, and consumers who choose environmentally friendly packaging are more likely to adopt sustainable disposal methods. 3D factory simulation software is very suitable for computer-aided participatory design of industrial workplaces and processes. This software can help designers, engineers, and operators understand and optimize the operational processes of factories by creating virtual models of the real world.

By simulating the 3D model of the software, Pelliccia et al. [11] accurately observed the layout of various equipment and machines in the factory, identifying potential problems and making improvements. In addition, simulation software can also optimize the distance and connection between equipment by analyzing processes and logistics, in order to improve production efficiency. Simulation software can help engineers predict potential faults that may occur during the production process. By simulating different operating conditions and equipment states, engineers can identify potential fault points and take preventive measures to reduce downtime and maintenance costs. Simulation software can provide operators with a safe and low-cost training environment. By simulating real operating interfaces and processes, operators can familiarize themselves with equipment and processes before actual operations, thereby reducing human errors and accidents. With the continuous development of data collection technology, high-dimensional data has been widely applied in various fields. High dimensional data usually contains a large amount of redundant information and noise, which poses great challenges to data analysis and processing. Feature selection is an effective method that can remove redundant information and noise, and improve the efficiency of data analysis and processing. The dimensionality reduction algorithm is an effective feature selection method that can transform high-dimensional data into data in a low-dimensional space while preserving the structure and information of the data. However, existing dimensionality reduction algorithms usually only consider the structure and information of the data, while ignoring the interactive needs of users for features. Rj and Wei [12] analyzed a new interactive high-dimensional feature selection algorithm based on dimensionality reduction. The basic idea of this algorithm is to introduce users' interactive requirements for features during the dimensionality reduction process, in order to obtain feature selection results that are more in line with user needs. Specifically, the algorithm first uses a dimensionality reduction algorithm to convert high-dimensional data into data in a low-dimensional space; Then, based on the user's interactive needs for features, feature selection is performed on low dimensional data to obtain the final feature selection result. Saleh et al. [13] analyzed the importance of high-quality product design based on computer-aided design. Computer aided

design (CAD) technology can improve the quality and efficiency of product design. By using CAD software, designers can more accurately simulate and predict the performance and effectiveness of products in different environments and conditions, thereby identifying and solving problems in the early stages of product development, and avoiding design defects. By integrating with computer-aided engineering (CAE) software, designers can introduce innovative technologies and methods in the design process, promoting the progress of product design. Schnurr [14] explored how cute packaging design can affect consumers' judgments of product taste and health. Through experimental research, it has been found that cute packaging designs make consumers more inclined to believe that products taste better, but do not affect their judgment of product health. The research results indicate that packaging design can to some extent affect consumers' initial perception of products, but it does not significantly change consumers' perception of product health. With the increasing awareness of health and environmental protection among people, consumers are increasingly paying attention to health factors in their product choices. Food packaging design is one of the important factors that affect consumers' purchasing decisions. The purpose of this study is to explore the impact of cute packaging design on consumers' judgments of product taste and health. Zhao et al. [15] used CAD software to create the initial design of agricultural product packaging. Designers can choose and modify different artistic styles, such as abstract art, natural style, hand drawn art, etc., to meet the characteristics of agricultural products and the needs of the target market. Create a 3D model using CAD software based on design sketches. At this stage, designers can meticulously depict every detail of the packaging, including color, texture, shape, etc., to ensure that the appearance of the final product is consistent with the design intent. By simulating and optimizing design, CAD software can help designers predict the performance of packaging under different conditions, such as color effects under different lighting conditions and deformation during transportation. This information can help designers identify problems in a timely manner and make adjustments to optimize the appearance of the final product. In summary, the appearance design of agricultural product packaging art style with intelligent computer assistance can be achieved using CAD software. This technology can improve design efficiency and accuracy, while reducing production costs and enhancing product market competitiveness.

At present, the research results are mainly aimed at the packaging design of specific brands or products, and the generalization ability of the algorithm needs to be further improved to adapt to a wider range of application scenarios. The packaging image processing algorithm based on feature coding and DL has important application value in CAD-aided brand packaging design process in graphic design teaching. In this article, a packaging image processing algorithm based on feature coding and DL is proposed. By extracting and adding features of packaging images, the process of CAD-aided brand packaging design in graphic design teaching is improved, and the design ability and efficiency of students are improved.

3 APPLICATION OF CAD IN GRAPHIC DESIGN TEACHING

CAD software can provide accurate graphic design, text processing, color management and other functions, making the process of graphic design more efficient and accurate. In graphic design teaching, the application of CAD software can not only improve students' design efficiency, but also cultivate their innovative ability and aesthetic ability. The traditional graphic design method needs to draw graphics manually, which is not only time-consuming but also low in accuracy. CAD software provides various drawing tools, which can draw various shapes quickly and accurately. CAD software provides a wealth of graphic editing tools, such as copying, moving, scaling, rotating, etc., so that students can design more conveniently. Secondly, CAD software provides text processing function, which can add various types of text in the design, including title, subtitle, explanatory text and so on. Moreover, CAD software also supports various formatting of the text, such as font, size and color, which makes the text play a better decorative role in the design. In addition, CAD software also provides color management function, which can conveniently select, mix and mix colors. Students can use various color tools to create harmonious color matching and

enhance the visual effect of design. Moreover, CAD software also supports the setting of transparency, which can create graphics and characters with transparent effect and further enrich the expression of design.

In addition to the above functions, CAD software also provides various special effects processing functions, such as shadows, gradients, textures, etc., which can enhance the layering and three-dimensional sense of design. For example, in brand packaging design, students can use CAD software to create a three-dimensional packaging effect diagram to show the appearance and characteristics of products. Moreover, CAD software also supports importing external image files, which can be combined with image processing software to further beautify the design effect.

In graphic design teaching, the application of CAD software can not only improve students' design efficiency, but also cultivate their innovative ability and aesthetic ability. By using CAD software, students can carry out creative design more freely and try various novel design elements and combinations. Moreover, CAD software also provides various design templates and plug-ins, which can help students create various types of design works quickly. By using CAD software, students can design more conveniently and accurately, and improve design efficiency and quality. Moreover, the application of CAD software can also cultivate students' innovative ability and aesthetic ability, and help them better adapt to the needs of future career development.

However, there are some challenges in the application of CAD software in graphic design teaching. First of all, students need to master the basic operation methods of CAD software and know how to use various tools and functions. Secondly, the operation of CAD software needs certain computer hardware configuration and operation skills, and the school needs to provide enough computer equipment and a good network environment. In addition, teachers need to constantly update their knowledge and skills to understand the latest development and application scenarios of CAD software.

4 PACKAGING IMAGE PROCESSING BASED ON FEATURE CODING AND DL

DL method has achieved excellent results in various computer vision fields, and greatly promoted the growth of image processing and recognition. Image feature transformation refers to the corresponding linear and nonlinear transformation of the extracted image features to further enhance the expressive ability of image features. This section will introduce the implementation of packaging image processing algorithm based on feature coding and DL in detail. Firstly, for feature coding, it is needed to extract representative features from images. These features can be color, texture, shape, etc. After feature coding, these binary tag sequences can be used as the input of DL model. DL model can automatically learn the inherent laws and characteristics of data, so as to effectively classify and identify packaging images. Convolutional neural network (CNN) is selected as the DL model. CNN is a neural network structure widely used in the field of image processing, which can automatically learn various levels of features from images. In the convolution layer, the input image is convolved by a series of convolution kernels, thus extracting various features in the image. The pool layer down-samples the convolution feature map to reduce the number of parameters of the model and improve the robustness of the model. Finally, the fully connected layer uses the extracted features for tasks such as classification and regression. Through the above steps, the packaging image processing algorithm based on feature coding and DL can be realized.

In the training stage of convolution filter, each category of convolution filter is trained by the corresponding category of pictures. After that, in the testing stage, the label of the test picture is determined by the reconstruction residuals of all kinds of convolution filters. By introducing the category information into the convolution filter that can capture the correlation between local neighborhoods, the proposed model has stronger image expression ability than the traditional sparse representation classification method, so the proposed model will also have better image processing performance. The residual network model structure of packaging image processing in this article is shown in Figure 1.

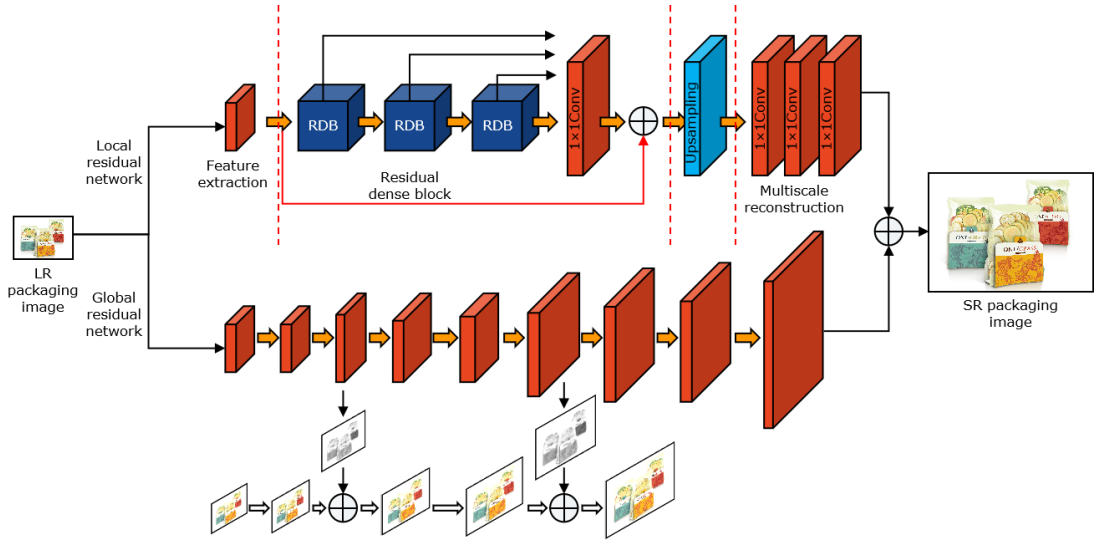

Figure 1: Residual network model.

The traditional sparse coding method assumes that the input samples are independent of each other in general. This independent assumption will lead to a problem when applied to image signals, that is, many atoms in the learned dictionary are shifted forms of other atoms, which will make the dictionary learn many similar or repeated atoms, thus weakening the dictionary's feature expression ability to some extent. In order to solve this problem, we can learn that convolutional sparse coding with shift-invariant filter is proposed. Unlike the sparse coding method based on image blocks, convolutional sparse coding uses convolution kernel to slide across the whole image, thus seamlessly capturing the association between local neighborhoods. The packaging super-resolution processing process is shown in Figure 2.

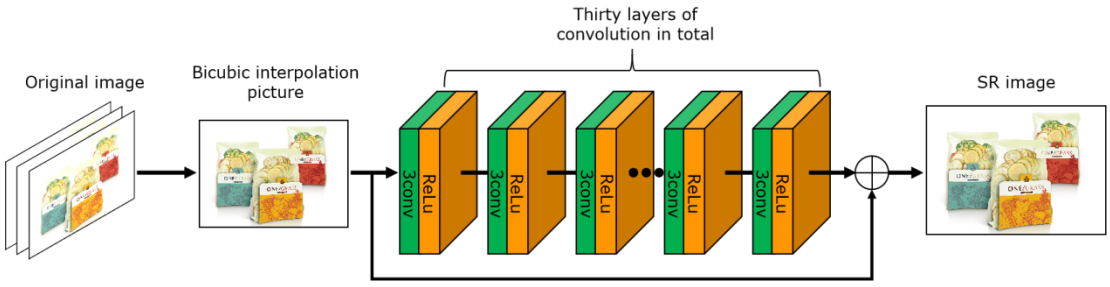

Figure 2: Packaging super-resolution processing.

Different from the traditional problem of image description generation, intensive image description generation needs to locate the semantic area in the image and describe it in natural language. Traditional algorithms generally use the method of target detection to locate semantic regions, and use the appearance information of local regions to generate natural language descriptions. In the field of image processing, many dictionary learning models can achieve very good image recognition performance because an adaptive and effective dictionary can be obtained from training pictures for image processing tasks. This article will focus on exploring the potential

relationship of multiple targets in the same picture, and use the appearance similarity and spatial position relationship to learn all the target areas in the image more accurately and fully.

Assuming that the packaging image size is $M \times N$, the gray level is $\{0,1,\cdots,L-1\}$, and the number of pixels in gray level i is n_i, the frequency of gray level i is:

$$p_i = \frac{n_i}{MN} \tag{1}$$

If the image pixels are divided into two types of C_0, C_1 by the threshold T, the probabilities are:

$$w_0 = \sum_{i=0}^{T} p_i,\ w_1 = 1 - w_0 \tag{2}$$

The average gray values of the two classes are:

$$\mu_0 = \frac{1}{w_0} \sum_{i=0}^{T} i p_i \tag{3}$$

$$\mu_1 = \frac{1}{w_1} \sum_{i=T+1}^{L-1} i p_i \tag{4}$$

Open operation is performed on image A through structural element B, which can be recorded as $A \cdot B$, and can be expressed as:

$$A \cdot B = (A \oplus B) \Theta B \tag{5}$$

The closing operation of brand packaging image is that brand packaging image A is firstly expanded by B, and then corroded by structural element B. Closing the image of brand packaging can not only smooth the image of brand packaging to a certain extent, but also connect the tiny broken parts and fill the tiny holes in the image of brand packaging.

Suppose a threshold value is marked as t, the percentage of pixels divided by the total number in the foreground is marked as ω_0, the average gray value in the foreground is marked as μ_0, the percentage of pixels divided by the total number in the background is marked as ω_1, and the average gray value in the background is marked as μ_1. The total gray mean and variance are:

$$\mu = \omega_0 \times \mu_0 + \omega_1 \times \mu_1 \tag{6}$$

$$g = \omega_0 \times (\mu_0 - \mu)^2 + \omega_1 \times (\mu_1 - \mu)^2 = \omega_0 \times \omega_1 \times (\mu_1 - \omega)^2 \tag{7}$$

When the variance is the largest, the difference between foreground and background is the most obvious. At this time, the corresponding threshold t is the best threshold, that is, the best threshold.

Although the convolutional sparse coding model has achieved good performance in many computer vision tasks, most of the existing convolutional sparse coding frameworks are unsupervised, that is, the class labels of images are not considered in the training stage of convolutional filters. Due to the richness of natural language text expression, it is a great challenge to supervise the generated description by using the annotation information of different language texts. In the unsupervised dictionary learning method, an unsupervised dictionary can be obtained by optimizing an objective function, the core idea of which is to minimize the reconstruction residual of training pictures without category labels. Although the dictionary constructed in this unsupervised way can faithfully reconstruct the training pictures, the trained

dictionary will not contain category information. Because the natural language text is very subjective and rich, the expression forms of the language text can be different when the semantics are the same, which makes it difficult for the image generation model based on the natural language text to maintain the semantic consistency of the image and the text.

Assuming that the input and output functions of packaging image feature information are expressed as R and R' respectively, the bilateral filtering discrete form expression of packaging image feature information is as follows:

$$R'=[k,\ j]=\sum_{m=-p}^{p}\sum_{n=-p}^{p}B[m,n,k,\ j]R[k-m,\ j-n] \tag{8}$$

Where p represents a pixel of packaging image feature information; m represents the variance of packaging image feature information; n represents the standard deviation of packaging image feature information; $B[m,n,k,\ j]$ represents Gaussian kernel function of packaging image feature information, and its calculation expression is as follows:

$$B[m,n,k,\ j]=\frac{\exp\left(-\frac{m^2+n^2}{2\sigma_{\delta}^2}-\frac{R[k-m,\ j-n]}{2\sigma_{\xi}^2}\right)}{R(k,\ j)} \tag{9}$$

Where σ represents the scale parameter of packaging image feature information. The above formula is used to smooth the feature information of packaging image to eliminate the influence of noise and keep the detailed information of packaging image features.

The algorithm can automatically extract the features of packaging images and classify and recognize them, with high accuracy and robustness. In the next section, the effectiveness of the algorithm will be verified by experiments, and its application in packaging image processing of graphic design teaching system will be discussed in depth.

5 MODEL TESTING AND ANALYSIS

The results on MNIST data set and CIFAR-10 data set will prove the effectiveness of the proposed model in the field of packaging image processing. The data set contains various packaging features and elements, which provides sufficient data support for the experiment. In the training stage, a large number of packaging image data are used for model training, and the accuracy and robustness of the algorithm are improved by learning the characteristics of sample data. In the testing stage, the author uses the test data set to assess the algorithm to determine the accuracy and efficiency of the algorithm. Before the algorithm test, all the packaging images are preprocessed to eliminate the noise and interference in the images and improve the quality and clarity of the images. In order to analyze the expressive ability and classification performance of the algorithm for packaging image processing, and study the influence of the number of training samples on the detection accuracy, the detection accuracy of the algorithm, GAN and CNN in different off-line training sample sets is tested, as shown in Figure 3, Figure 4 and Figure 5.

On the basis of retaining the main information, this algorithm improves the classification performance and the accuracy of brand pattern integrity detection. The algorithm performs well in the accuracy of packaging image detection, and can effectively identify and classify various elements in packaging images. For different types of packaging images, the accuracy of this algorithm is slightly different. But overall, the performance of this algorithm in detecting packaging images is still outstanding. The image processing effect of three commodity packages is shown in Figure 6.

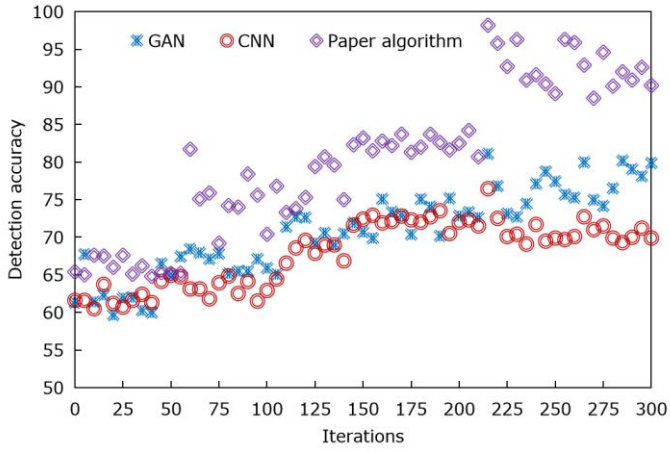

Figure 3: Classification performance of commodity 1.

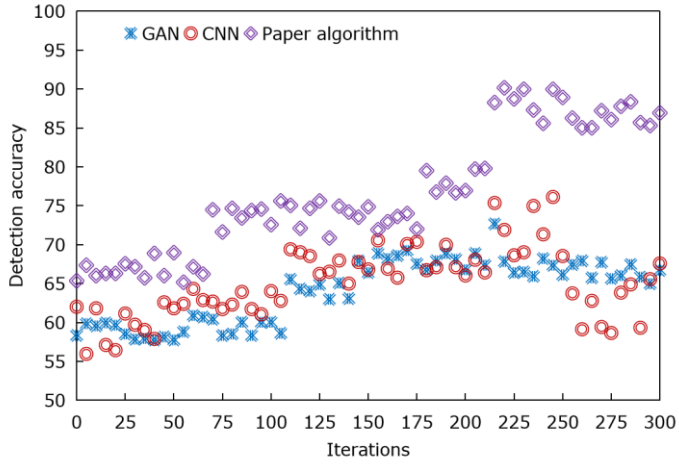

Figure 4: Classification performance of commodity 2.

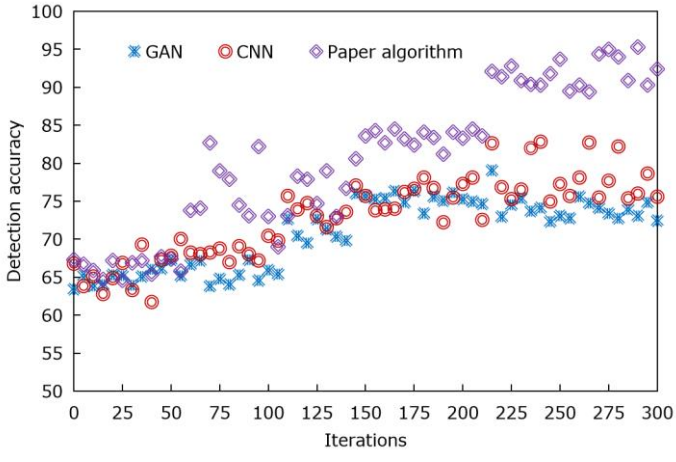

Figure 5: Classification performance of commodity 3.

Figure 6: Packaging image processing effect.

The processing time of packaging characteristics optimization by different methods is shown in Figure 7. The simulation results show that the algorithm is very effective in optimizing the processing time of packaging features and can significantly improve the processing efficiency.

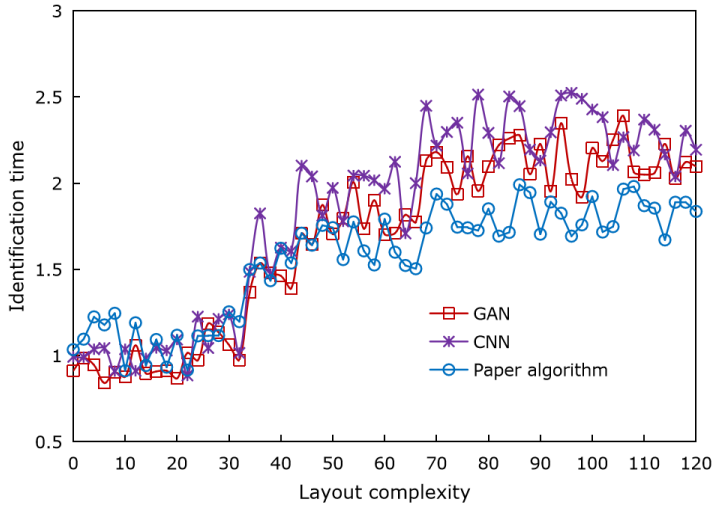

Figure 7: Comparison of packaging feature recognition time.

Through the analysis of Figure 7, it is found that the packaging image processing method in this study takes less time and shows higher operation efficiency, which can effectively assist the improvement of packaging CAD design method in graphic design teaching. The optimization time of the algorithm is affected by many factors, including image quality, resolution, lighting conditions, complexity of packaging images and so on. In some cases, the algorithm may be affected by background noise or other interference factors, resulting in an increase in optimization time. By improving the algorithm and optimizing parameters, this article successfully reduces the optimization time of the algorithm and improves the running efficiency. The application of this model can provide feasible methods and techniques for graphic design teaching.

6 INSTRUCTIONAL METHOD

By discussing the application of CAD in brand packaging design and the integration of graphic design teaching and CAD, this article puts forward a series of instructional methods. These methods aim at improving students' design ability and efficiency, and at the same time cultivating their innovative thinking and practical ability.

Case teaching: Through the analysis of successful brand packaging design cases, let students understand the application of CAD in practice. Teachers can choose some representative cases to guide students to analyze their design principles, design ideas and implementation process, so as to deepen their understanding and mastery of CAD design. Moreover, through case analysis, students can understand the basic elements and norms of brand packaging design, and lay the foundation for subsequent design practice.

Practice teaching: let students use CAD technology in practical design tasks to improve their practical ability. Teachers can set the theme or task of brand packaging design, and ask students to use CAD software for practical operation to complete the design works. In this process, teachers can give guidance, answer questions and help students solve practical problems and difficulties. Through practical teaching, students can deeply understand the actual operation and norms of brand packaging design and cultivate their practical ability and innovative thinking.

Reflective teaching: let students reflect on their design process and results, so as to improve their design level and independent thinking ability. Teachers can ask students to write a design reflection report, summarize the experience and lessons in the design process, analyze the advantages and disadvantages of the design works, and put forward improvement plans. Through reflective teaching, students can think deeply about the basic principles and methods of brand packaging design, deepen their understanding and mastery of design norms and standards, and improve their design level and aesthetic ability.

7 CONCLUSIONS

In the process of contemporary teaching, computers have become an inseparable and important tool, which not only brings convenience to teachers, but also constantly enhances the status of informatization in the classroom. Packaging design should not only reflect product characteristics and brand value, but also be consistent with contemporary people's ideological and cultural values. This article discusses how to integrate CAD into brand packaging design in graphic design teaching. Through the design and test of image processing algorithm, the clarity and vividness of packaging images are improved. Moreover, by discussing the application of CAD in brand packaging design and the integration of graphic design teaching and CAD, a series of instructional methods are put forward, including case teaching, practice teaching and reflection teaching. These instructional methods aim to improve students' design ability and efficiency, and cultivate innovative thinking and practical ability. Through the design and test of the proposed image processing algorithm, the effectiveness and superiority of the algorithm are proved, which can effectively assist the improvement of packaging CAD design method in graphic design teaching. The next research can further explore the application of CAD in brand packaging design, and how

to integrate and optimize it with other design software and tools. Moreover, we can further study how to apply the instructional method proposed in this article to practical teaching, and assess and improve it to improve the teaching quality and effect.

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