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Computer-Aided Design AND APPLICATIONS

Image Feature Extraction and Interactive Design of Cultural and Creative Products Based on Deep Learning

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Abstract. Informatization has brought value recognition in terms of aesthetic feeling of product design and emotional resonance. Interactive Wenchuang (Cultural and Creative) products combine modern interactive technology with traditional Wenchuang forms, which has attracted wide attention. Based on the design concept of interactive Wenchuang products, this article combines deep learning (DL) model and computer aided design (CAD) to extract image features of Wenchuang products. In order to solve the problem of great similarity difference among samples in the stage of feature detection, a similarity preserving method based on depth metric learning is proposed to optimize sample mining and loss. The simulation test shows that the accuracy of image feature detection method based on DL is higher than that of image feature detection method under the condition of normalized image gray level and uncertain angle. The visual inspection system designed in this article can identify the characteristics of products quickly and accurately, and has certain practicability.

Keywords: Deep Learning; CAD; Wenchuang Products; Image Features
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1 INTRODUCTION

Wenchuang product is a product that combines culture and creativity with the goal of making profits and spreading culture under the background of cultural industry. It has both commodity attributes and additional cultural attributes. Informatization has brought value recognition in terms of aesthetic feeling of product design and emotional resonance. Digital photography technology can be used for the shooting and recording of cultural relics, including their appearance, details, and texture. Digital measurement technology can achieve high-precision measurement and dimensional restoration of cultural relics through image processing and 3D modeling. Abdelhamid

[1] conducted digital measurements of cultural relics and panoramic virtual tourism interactions using 2D and 3D models. And use these data to construct a three-dimensional model of cultural relics. This technology can be applied to the digital protection and reconstruction of cultural relics, as well as for virtual exhibitions and public displays, allowing users to experience the details and characteristics of cultural relics more realistically. Through digital technology, damaged or missing cultural relics can be restored and restored, and cultural relics can also be simulated to test their historical significance and value. Through the application of digital technology, cultural heritage and cultural heritage resources can be better protected, inherited, and developed. At the same time, these digital records can also provide rich data support for research in related fields, promoting the development of cultural heritage protection. However, it should be noted that digital technology is only one of the means of protecting cultural heritage and needs to be combined with other protection measures to achieve comprehensive protection and inheritance of cultural heritage. Compared with the traditional design mode, CAD has an advantage with its superior skills and more personalized design. At present, it has also solved some realistic problems that Wenchuang products are difficult to achieve and have low accuracy. Amura et al. [2] conducted automated search area recognition for two-dimensional code quantitative analysis. When analyzing and extracting features from artwork diagnostic images, it is necessary to ensure that the integrity and authenticity of the artwork are not compromised. This includes selecting appropriate analysis methods, controlling the analysis process, and avoiding excessive processing. Select appropriate image processing methods, feature extraction algorithms and Data and information visualization technologies according to specific art types and analysis requirements to improve the accuracy and efficiency of analysis and identification. At the same time, it is necessary to consider the adaptability and scalability of the method to cope with different types and sizes of artwork images. By comprehensively utilizing technologies such as digital image processing, computer vision, and deep learning, combined with the construction and use of databases and knowledge bases, the analysis and feature extraction of art diagnosis images can be more effective, improving the accuracy and reliability of art protection and identification. At the same time, the reasonable selection and application of methods to ensure that they do not damage the integrity and authenticity of the artwork, and continuously pay attention to technological innovation and development to adapt to the increasingly complex and diverse needs of artwork protection and appraisal. Interactive Wenchuang products combine modern interactive technology with traditional Wenchuang forms, which has attracted widespread attention and narrowed the distance between people and Wenchuang products. Bäuerle et al. [3] conducted deep learning to ensure the development of image processing technology. Through high-precision 3D pose analysis of network neural images, it provides relevant training for sample setting automation. Train deep neural networks using preprocessed data. This network can be a Convolutional neural network (CNN) or a point cloud processing network (PointNet), which is used to learn the laws of 3D attitude estimation from CAD models and scanning data. Use independent test datasets to test and evaluate the trained deep neural network. These test data can include different ECU models, operating conditions, and environmental conditions to evaluate the robustness and generalization ability of the model. By applying the trained deep neural network to practical industrial use cases, 3D pose estimation of ECU can be achieved. This can be applied to multiple fields such as automated production lines, robot operations, quality control, etc., in order to achieve automation and optimization of industrial processes. The shapes and colors of Wenchuang products can convey specific cultural images, and have artistic appeal, which is an important part of designers' creative thinking and affects consumers' purchasing decisions. Chan et al. [4] conducted a three-dimensional fashion printing theoretical model accessory analysis for creative design. In designing prototypes, it is necessary to consider the shape, size, details, and distribution of multicolored textures of clothing. Designers can innovate and adjust according to market demand and trends until a satisfactory design solution is achieved. In 3D printing software, designers can use different materials and colors to create clothing with multi-color textures. You can achieve a combination of different colors and texture effects by adjusting material parameters, color gradient methods, and texture map distribution. This can make clothing more vivid, rich, and visually impactful. After

completing the design of multi-color textures, output the 3D model to a 3D printer for manufacturing. Select appropriate 3D printing technology and materials according to design requirements and material characteristics, such as fused deposition modeling (FDM), light curing (SLA), etc. Through 3D printing technology, physical prototypes of textiles and clothing with multi-color textures can be quickly manufactured. Improving the rationality of image communication of Wenchuang's product design is of great significance to the effective communication of regional culture, the protection and inheritance of excellent culture and the enhancement of the market competitiveness of products. In the design and growth of new Wenchuang products, product designers can constantly try and explore, improve the charm and value of Wenchuang products, and deeply explore the HCI experience presented by the combination of new Wenchuang product design and CAD. Chang [5] used 3D computer-assisted model printing for style deconstruction analysis of artistic patterns. Parametric design has a wide range of applications in creating 3D models with woven features. Through parameterized design, 3D models with woven features can be quickly and accurately created to meet the needs of different fields. In textile design, 3D models with weaving features can be used to simulate and display textiles of different materials, textures, and structures. Through parameterized design, the style, density, direction, and other parameters of woven patterns can be adjusted to achieve different textile designs and creative effects. In pattern design, 3D models with woven features can be used to simulate and display the appearance and structure of furniture. Through parameterized design, the shape, density, direction and other parameters of the weaving structure can be adjusted to achieve different furniture designs and creative effects.

Fan and Li [6] conducted innovative technology innovation in feature point graphics for object graphic information. Through the analysis of the design of Computer graphics information transmission interface in Cognitive psychology, it constructs the transformation of visual communication mode of graphic information transmission. Computer graphics can be used to create and render 3D models and scenes. Through 3D modeling software such as Blender, Maya, etc., various complex 3D models can be created, and through rendering engines such as Arnold, Vray, etc., the material, lighting, shadow, and other effects of the model can be simulated and presented. In Visual communication, 3D modeling and rendering can be used to create three-dimensional and realistic posters, advertisements, packaging and other design works. Computer graphics processing can be used to synthesize and combine different images, graphics and elements to achieve innovative and special effects. By using compositing software such as Adobe After Effects, different media such as images, videos, and audio can be synthesized and various special effects can be added. Such as dynamic text, animation, particle effects, etc., to create Visual communication works with visual impact and attraction. Compared with traditional feature detection methods, the feature detection algorithm using deep neural network can simultaneously extract the bottom features and high-level semantic information of the image. The earliest graphic image processing was mainly an activity aimed at satisfying people's clarity of image quality and the best visual effect, and it was not further applied to production and life, which can be said to be a purely artistic requirement. Therefore, in the stage of processing, it is mainly to modify the image with low resolution and poor image quality, so that the modified image can give people the best visual effect. The graphic information is converted into digital information and stored in the computer, allowing users to perform digital information operations on images by operating the computer. Therefore, one of the keys to image processing lies in the computing power of computers. However, the computing power of a computer is often limited by the software carried in the computer and the hardware that makes up the computer. This means that if the computer's computing power is insufficient, the speed and effectiveness of image processing may be affected. Convolutional neural network (CNN) can automatically learn the appropriate expressions of the underlying features from the pixel information of the image, such as color, detail texture, target shape and so on. Moreover, it will also learn the high-level semantic information and topological structure of the image, and the extracted feature richness will be greatly improved. Based on the design concept of interactive Wenchuang products, this article combines DL model to extract image features of Wenchuang products, and studies the innovative application of CAD in

Wenchuang product design, with a view to promoting the integrated growth of interactive design and Wenchuang products.

Fan et al. [7] conducted an analysis of the composition of human history, providing a new perspective for studying immersive cultural digital human information services. It explores a non-contact virtual reality cultural service system. CAD can display important cultural relics and artworks of historical figures through virtual exhibitions. Users can interactively rotate, scale, and move these digital replicas to carefully observe the details and characteristics of historical relics. Through CAD's immersive cultural heritage digital literature and information services, historical figures Metaverse can provide users with a richer and more vivid historical experience. This helps stimulate users' interest and love for history, and promotes the inheritance and development of historical culture. At the same time, this digital approach can also protect and preserve precious historical and cultural heritage, allowing more people to understand and appreciate the value of these cultural heritage. From the perspective of software production, in fact, whether it is product modeling design or industrial modeling design, it can be divided into appearance diagram and structure diagram representation. Computer image processing technology is used to understand and analyze images, which usually refers to preprocessing, segmenting, detecting the characteristics of objects in images and describing them with some data structure. Further analysis also includes classification, recognition and understanding according to image content. In the growth of various application fields of computer vision, the method of feature detection based on DL has far surpassed the traditional feature detection algorithm in robustness, efficiency and recognition accuracy, but there are still many shortcomings that need to be continuously optimized and improved. In this article, the application of DL and CAD in image feature detection and interactive design of Wenchuang products is studied. Compared with the traditional DL model, the following innovations are made:

(1) This article describes from the perspective of color features. According to the distribution of each parameter, the parameter with smaller standard deviation is selected as the input feature vector of the classifier. And principal component analysis is used to extract features, which reduces the dimension of texture features, eliminates the correlation between pattern features, highlights their differences and meets the input requirements of recognition layer.

(2) In order to solve the problem of great similarity difference among samples in the stage of feature detection, a similarity preserving method based on depth metric learning is proposed, which optimizes sample mining and loss, and carries out experiments on industrial product data sets.

In this article, the feature detection method of Wenchuang product image based on DL and CAD is studied to optimize the HCI experience of Wenchuang product design. The effectiveness of this method is tested by simulation experiments. Finally, the research results are summarized, and the shortcomings of the current model and the direction of further research are pointed out.

2 RELATED WORK

Hu et al. [8] conducted highly personalized parameterized pattern market visual requirements. It constructs a complex mathematical model for ethnic consumers. Through the visual cognitive changes of batik patterns, the paper designs the connotation of Ethnic religion based on the fuzzy non artificial neural network model. Prepare a dataset of ethnic patterns, including various styles, styles, and cultures of ethnic patterns. These patterns can be sourced from literature, actual collection, or hand drawn. The dataset needs to be preprocessed and annotated in order to be used for training and testing of neural networks. The training process uses the neural network, and adjusts the network parameters through the Backpropagation to minimize the error between the predicted results and the actual results. The training process can be carried out in stages, gradually increasing complexity and diversity from simple patterns. After the training is completed, a neural network model can be used to automatically generate ethnic patterns. Enter a simple

initial pattern or keyword, and the neural network will generate a pattern with ethnic style based on shape grammar rules and learned features.

In past projects, designers and engineers often used 3D visualization programs to present their design concepts and project plans. These programs typically have high-quality graphics engines and modeling tools that can create realistic 3D scenes. Prior to the Vltava River Valley Dam project, CAD modeling had been widely applied to the planning and design of various construction and engineering projects. CAD software typically provides various modeling tools, including wireframe, surface, and volume modeling, which can be used to create various types of 3D models. Janovský et al. [9] selected CAD software to visualize the 3D model of the shape program and constructed a scene of the virtual valley state. In the Vltava Valley Dam project, designers and engineers can use these 3D visualization programs and CAD modeling software to create and manage 3D models of the dam. These models can be rendered, animated, and interactively browsed through programs to help decision-makers better understand the scale, structure, and environmental impact of the project. Liu et al. [10] conducted a virtual simulation digital design of Yue Opera costumes. The cultural characteristics of modern conceptual clothing were highlighted through CAD 3D virtual simulation. CAD (Computer-aided design) virtual simulation is a technology that uses computer technology to design and simulate clothing. Through CAD software, clothing designs can be created and modified, and virtual fitting and adjustment can be carried out, greatly improving design efficiency and fitness of ready-made clothing. Fashion design is the process of creating and implementing fashion art and functionality. In the costume design of Shaoxing Opera elements, we need to consider the historical and cultural background of the costume, as well as the modern aesthetic and Functional requirement. In the virtual simulation and clothing design of Yue Opera clothing CAD based on elements of Yue Opera, the above aspects need to be comprehensively considered. By using CAD software for clothing design and virtual simulation, it is possible to better integrate the presentation of Yue Opera elements with modern fashion. At the same time, through the use of different textile materials and technologies, we can create clothing works that have both traditional cultural charm and meet modern aesthetic and Functional requirement. Martinez et al. [11] conducted an important analysis of the cultural application of architectural elements. It constructs image application extraction for photogrammetry. The usability value of archival cultural applications was measured through the construction of historical building plan drone survey elements using three-dimensional models. Use CAD software or other 3D modeling tools to construct a 3D model of cultural heritage based on the processed data. In the modeling process, image processing techniques can be combined to map the image as a texture onto the 3D model to increase the details and realism of the model. By comparing and analyzing images and laser scanning data at different time points, potential changes and damage to cultural heritage can be detected. This can help cultural heritage protection workers develop targeted protection measures and evaluate the effectiveness of protection work. The generated 3D model can be used for virtual display and visual analysis. By rotating, scaling, and roaming cultural heritage in a virtual environment, users can gain a deeper understanding of the details and characteristics of cultural heritage. Pepe et al. [12] reconstructed images of cultural heritage through the motion of unmanned aerial vehicles using a 3D model of multi perspective stereoscopic images. The SfM MVS method can achieve fast and accurate 3D modeling through automated algorithms, reducing reliance on manual intervention. It can achieve high-precision Iterative reconstruction and modeling through multi view image matching and analysis. By adding more image perspectives, the accuracy and completeness of the model can be improved. Motion Structure (SfM) is a computer vision algorithm used to reconstruct 3D scene structures from images taken from multiple different perspectives. This algorithm detects feature points in the image and uses camera pose information to calculate camera motion, thereby generating a 3D model. The Multi View Stereo (MVS) algorithm is a method of reconstructing 3D scenes from multiple images from different perspectives. This algorithm matches corresponding points in multiple images and uses triangulation technology to calculate the position of objects in 3D space. This method can generate high-quality 3D models and has been widely used in the processing of drone aerial images. Combining SfM and MVS algorithms can more accurately

reconstruct 3D scene structures and provide more accurate model data. The application fields of these algorithms include urban planning, building modeling, archaeology, terrain analysis, and many other fields.

Tian [13] has carried out artistic preservation of 3D models of emerging ancient buildings using digital technology. It has created a digital model protection architecture for precious cultural relics. Publishing and displaying the established 3D model can help more people understand and appreciate the cultural value of ancient architecture through virtual exhibitions, internet platforms, and other means. In addition, 3D models can also be used for the restoration and reconstruction of ancient buildings, providing reference and support for actual protection work. By combining AutoCAD and 3Dmax for 3D modeling and digital preservation of ancient buildings, it is possible to comprehensively record and visualize the structure, appearance, and historical culture of ancient buildings. At the same time, this technology can also be applied to the protection and inheritance of other historical and cultural heritage, providing important digital support for research and management in related fields. The Fuzzy Kano Model is a method used to evaluate satisfaction, which considers the fuzziness and continuity between satisfaction and defects. This model uses a two-dimensional matrix to describe the relationship between satisfaction and defect level, collects consumer feedback information through questionnaire surveys or other methods, and then fuzzily processes and analyzes the feedback information. The product appearance design based on consumer perceptual image and the satisfaction evaluation of fuzzy Carnot model are a closed-loop process that comprehensively considers consumer needs and expectations. Wu [14] conducted the quality model design and construction of consumer preference images. Based on the feedback information collected, a fuzzy Carnot model is used for analysis. By calculating the values of satisfaction and defect degree, the quality of product appearance design can be determined. Based on the analysis results, optimization suggestions can be proposed, such as improving design, adjusting color matching, and adding personalized options for users, to improve the satisfaction of the product among target consumers. Wu and Zhang [15] conducted intelligent product image model recognition for cultural and creative products. It carried out an effective experiment on the construction of deep learning convolutional network for Oil-paper umbrella image recognition. A large amount of oil paper and bamboo umbrella image data needs to be collected, including samples of various styles and designs. These data can come from networks, libraries, museums, etc. For the collected image data, preprocessing is required, including size normalization, color space conversion, image enhancement, etc., to improve subsequent recognition accuracy. Use deep learning models for feature extraction. Here, Convolutional neural network (CNN) can be used for feature extraction, such as VGG, ResNet and other classical models. Train the model to automatically learn the feature representation of the image. After obtaining the feature expression of the image, it can be input into a classifier for style classification. According to the output of the classifier, Intelligent design can be further carried out. For example, based on the style chosen by the user, certain features can be highlighted or weakened in the design. This can be achieved by adjusting design parameters or using methods such as Reinforcement learning. Xu et al. [16] conducted a design measurement of target network matching patterns for color images. The color network model is an algorithm model that converts black and white images into color images. This model considers each pixel in a black and white image as a node, and assigns different colors to each node by transforming their relationship with surrounding pixels into a network structure. In CAD assisted color combinations, designers can use CAD software to develop color rules and combinations to guide color network models in assigning colors to each node. These rules and combinations can be adjusted and optimized according to design requirements and goals. In the process of converting black and white images into color images, the color network model first extracts each pixel in the black and white image and maps it to a color space based on its grayscale value.

Then, according to the rules and combinations defined in CAD assisted color combinations, assign one or more colors to each node to achieve the conversion from black and white to color. Xu and Zheng [17] conducted an overall analysis of data for image project visualization. It constructs a deep correlation project expression of image sub patterns through visual interaction

factor analysis of data. By utilizing computer perception image systems, cultural and creative products can be designed through various software tools. For example, you can use CAD (Computer-aided design) software to design a plan or 3D model, and use Photoshop and other image processing software to design colors and materials. And creative products can be displayed in computer-generated virtual environments, providing a more intuitive and vivid experience. This can help designers better grasp the final effect of the product in the early stages, while also allowing users to have a deeper understanding and experience of the product. Through image recognition technology, images of cultural and creative products can be analyzed and key features can be automatically extracted. Based on these features, intelligent optimization algorithms can be used to improve product design, such as optimizing shape, size, color, and other aspects, in order to enhance the aesthetics and functionality of the product. Zeng [18] analyzed the problem of building image resolution recognition in high-resolution complex images. High resolution satellite remote sensing image data needs to be prepared, including the original data and preprocessed data of satellite images. The preprocessing steps may include image enhancement, image segmentation, feature extraction, etc., in order to better prepare data for training deep learning models. Use the trained model to recognize and extract buildings from new satellite remote sensing images. Firstly, input the image into the model, and then perform building recognition and extraction based on the output results of the model. Techniques such as threshold segmentation, morphological operations, and edge detection can be used to extract building contour and shape information. The widespread application of satellite remote sensing technology, building recognition and extraction methods based on deep learning in satellite remote sensing images will continue to develop and improve, providing more accurate and reliable data support for related fields. Zhao et al. [19] carried out Intelligent design for the original ecological product consumption of agricultural products' cultural value. With the assistance of intelligent computers, agricultural product packaging can be designed with artistic style to enhance its attractiveness and market competitiveness. Intelligent optimization algorithms can help designers find the best artistic style combination in agricultural product packaging design. These algorithms can find the design solution with the highest aesthetics and market potential through iteration and optimization of design parameters. Through the application of intelligent Computer-aided design, the artistic style appearance design of agricultural product packaging can be carried out more quickly, accurately and flexibly. However, it should be noted that designers also need to consider and make decisions comprehensively based on factors such as market demand, product positioning, and process feasibility, to ensure that the final design scheme has practical feasibility and can meet user expectations and needs. In addition, intelligent Computer-aided design can also play a role in the sustainability of agricultural product packaging. The graphic drawing function in Cad software can be used to design and draw the contours, details, and decorations of jewelry. Students can use various drawing tools, such as lines, curves, arcs, etc., to create their own unique Jewellery design. Zheng and Chang [20] can help students better understand the skills and methods of Jewellery design and improve their own design level through graphic drawing. The rendering and shading functions in Cad software can be used to simulate the appearance and texture of jewelry. Through rendering and coloring, students can observe the effects of jewelry designed by themselves in different angles, light and materials in a virtual environment, and better grasp the visual effects and aesthetic rules of Jewellery design.

3 METHODOLOGY

3.1 Wenchuang Product Image Feature Detection

CAD can also help Wenchuang product designers to complete scheme comparison, design content retrieval, drawing design review and so on, which greatly shortens the product design cycle and improves the efficiency of product design. The CNN model of product image feature detection is shown in Figure 1.

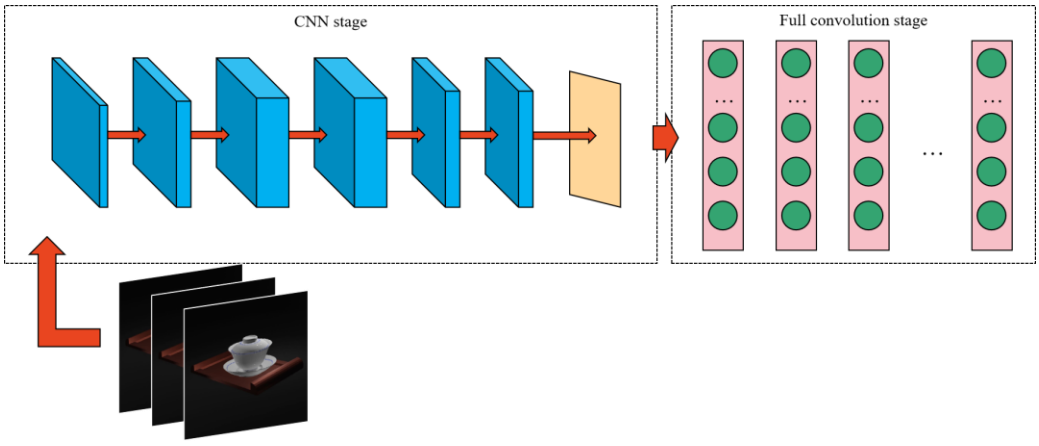

Figure 1: CNN model of product image feature detection.

Scale-invariant feature transformation feature is an image target extraction method based on the feature points of local appearance on an object, and the idea of this method is to increase the resistance to the influence of image scale, rotation angle change and light occlusion as much as possible, thus reducing the influence in the extraction process. The effect of this feature is that features are relatively easy to obtain, the probability that the target object with obvious features is recognized incorrectly is relatively small, and the probability of successful recognition of partially occluded objects is relatively high. In general, the quantity of free parameters in neural network is relatively small.

CNN operation process is defined as:

$$s(i,j)=(X*W)(i,j)+b=\sum_{k=1}^{n_{in}}(X_k*W_k)(i,j)+b \tag{1}$$

In general practical work training, it is rare to start training directly from the first layer, but by training the model in advance on a large data set, and then fixing the parameters of the layer in front of the model. Then when dealing with the current problem, only the last few layers are modified and fine-tuned with the data of the current problem. Given a picture with a fixed size, the classifier will calculate and judge whether it is true or not. After improving the classifier, the key to make it a detector that can detect images is to generate windows from multiple scales on the original image, set them to a fixed size, and then send them to the classifier for judgment. When the model has been trained for the previous task, the parameters can be updated by our own data set. When the amount of data is large, starting from scratch training is necessary because a large amount of data can provide sufficient information to train the entire network. Starting from scratch training can better utilize this data to learn features and patterns. In addition, training from scratch can also avoid overfitting, as a large amount of data can provide more samples for learning, thereby making the model more generalized.

Color histogram is a common method for color feature detection. The key point of this method is to count the times of various color information appearing in an image in a certain color space, and then calculate to get some feature information of the image. The color feature detection method can describe the color distribution in the image simply and quickly, and get the proportion of the color distribution in the whole image. Moreover, it has the characteristics of scale invariance, rotation invariance, translation invariance and superposition.

The color feature of the target can be expressed by the color threshold in a certain color space. For simple applications, the threshold range of the target color can be given directly. Taking RGB color space as an example, the model of color threshold can be expressed as:

$$f\left(P(R,G,B)\right)=\begin{cases}1 & R\in\left[R_{\min},R_{\max}\right]\&\,G\in\left[G_{\min},G_{\max}\right]\&\,B\in\left[B_{\min},B_{\max}\right]\\ 0 & \text{otherwise}\end{cases} \tag{2}$$

According to the method of color moment, color information can be expressed by the low-order moments of image color, which mainly refer to the first moment (mean E), the second moment (standard deviation σ) and the third moment (slope t) of each color component, and they have been proved to be effective in reflecting the color distribution of the image.

Let the j pixel of the i-th color component be p_{ij} and N be the target total quantity of pixels, then the first three moments of the i-th color component are defined as:

$$E_i=\frac{1}{N}\sum_{j=1}^{N}p_{ij} \tag{3}$$

$$\sigma_i=\left(\frac{1}{N}\sum_{j=1}^{N}\left(p_{ij}-E_i\right)^2\right)^{\frac{1}{2}} \tag{4}$$

$$t_i=\left(\frac{1}{N}\sum_{j=1}^{N}\left(p_{ij}-E_i\right)^3\right)^{\frac{1}{3}} \tag{5}$$

In the image histogram, all the color data are obtained after computer statistics, which clearly describes the color distribution state and quantity in the whole image, and at the same time, the basic tone of the image and the color distribution information of the image can be reflected from the histogram, which can provide a good reference for the next image processing, and its biggest disadvantage is that the related data of the image spatial position relationship will be lost.

3.2 Wenchuang Product Interaction Design Optimization

The problem of selecting multiple windows is inevitable when using support vector machine to classify pictures. Non-maximum suppression processing will be used here. First, we need to set a fixed window, and the size of this window is determined by the image size. Then, a fixed-size window is used to detect the smooth moving window on images of multiple scales, and then the confidence of the classification result of support vector machine is mapped to the score of the detection output. Wenchuang products often contain a variety of color combinations, and it is more in line with users' cognitive habits to evaluate users' image perception preferences for color schemes by using language descriptions. Moreover, in order to effectively reflect users' image perception of color design of Wenchuang products, it is necessary to introduce multi-user groups to participate in the color matching design process, and constrain the color matching design solution process from two aspects: cognitive consistency and satisfaction of user groups. The output scheme can better assist industrial designers in color matching design of Wenchuang products. Select a picture in a data set and use the directional gradient histogram method to extract features. The purpose of this is to have a general understanding of the dimensions of the obtained feature data, so as to determine the relevant parameters of scale-invariant feature transformation features.

According to the data structure and data type selected in this article, the parameters can be designed in this way when implementing the feature detection scheme of directional gradient histogram, and the quantity of feature points is the best quantity of feature points returned by the algorithm after ranking the detected feature points. A degree of target change, measured by relative scale change factor:

$$\eta_h = \frac{|h - h_1|}{h} \times 100\% \tag{6}$$

In this case, the change in relative similarity, which is the difference in similarity between the current target template and the target template in the previous frame, can be recorded. By comparing the changes in similarity, the relative similarity of the target template can be evaluated and whether the new location is still the same target can be determined. Assuming that the similarity between the target template in the current frame and the target template in the previous frame is 0.95, and the threshold is 0.8. The change in relative similarity is 0.15, which exceeds the threshold, so it can be considered that the target is still the same at the new location.:

$$\eta_\rho = \frac{|\rho_1 - \rho|}{\rho_1} \times 100\% \tag{7}$$

Compare η_ρ with threshold σ_ρ. DL's PointNet network structure is shown in figure 2.

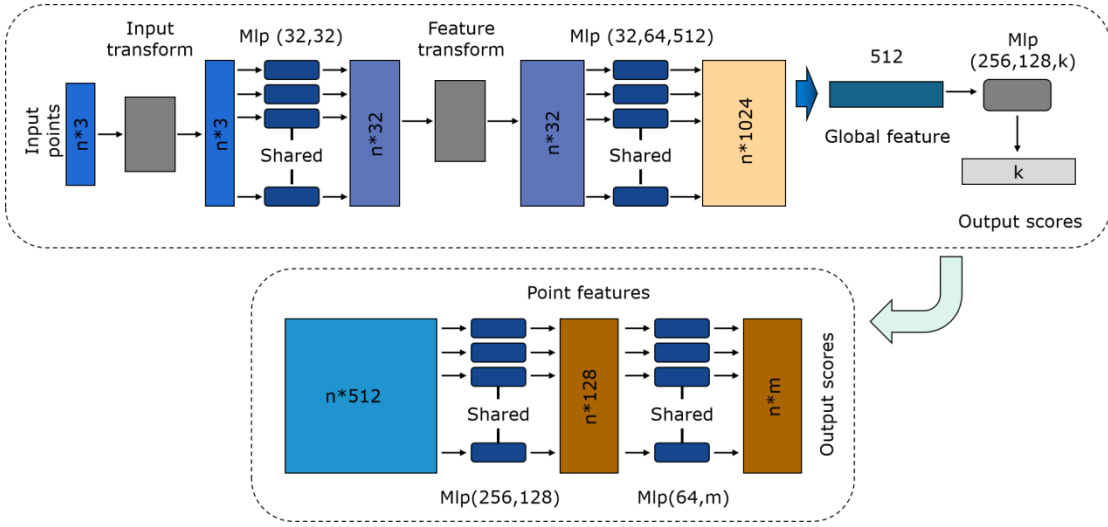

Figure 2: PointNet network structure.

If only the most difficult samples are selected for training, many samples may not be samples that need to be learned, but may be noise samples instead. However, if the method of indiscriminate sampling is adopted, it may lead to too many pairs of training samples and most of them are meaningless. If the method of defining difficult samples is adopted, it is necessary to add an artificially set super-parameter. These methods revolve around which samples are most suitable for training and learning. In the metric space, the network is actually concerned about whether the result list calculated according to the features extracted from the query samples is correct.

$$m_2D(x,y) = \sqrt{L_x^2 + L_y^2} \tag{8}$$

$$\theta(x,y) = \tan^{-1}\left(\frac{L_y}{L_x}\right) \tag{9}$$

$$m_3D(x,y,t) = \sqrt{L_x^2 + L_y^2 + L_t^2} \tag{10}$$

$$\theta D(x,y,t)=\tan^{-1}\frac{L_y}{L_x} \tag{11}$$

$$\phi(x,y,t)=\tan^{-1}\frac{L_t}{\sqrt{L_x^2+L_y^2}} \tag{12}$$

In this method, the accuracy of the candidate list calculated by the features returned by the current training network is used to evaluate the metric space, and the failed samples are given different degrees of punishment. In the list results finally obtained by the network, at least the images with similar semantics to the query samples should be arranged in front of the irrelevant images. So as to ensure that the correct samples can be ranked as far as possible in the results when the metric space cannot be optimized to best distinguish different types of samples.

4 RESULT ANALYSIS AND DISCUSSION

First, the positive sample is trained, which can be intercepted from the positive training sample according to the positioning frame and scaled to the size of 64*128. Then train negative samples, which need to be randomly intercepted from negative training samples without target objects. Compare the convergence performance of the traditional ML method with the DL method proposed in this article in the maximum cluster structure (see Figure 3).

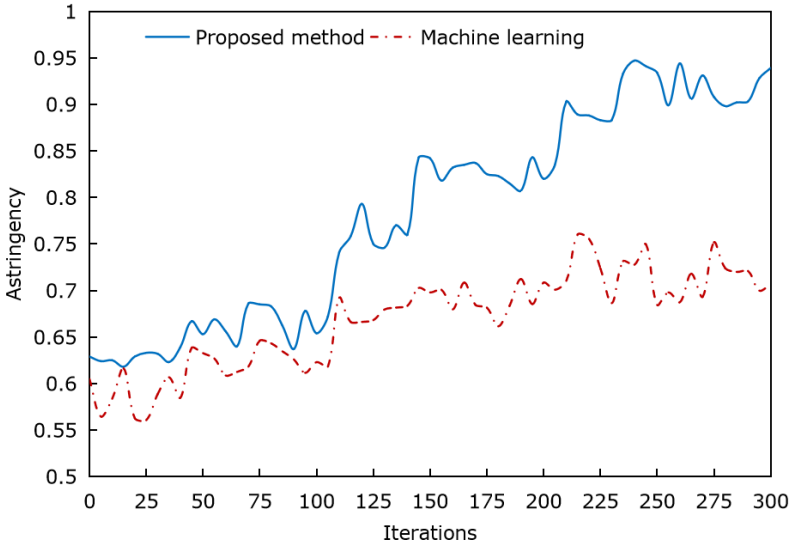

Figure 3: Convergence test results.

Experiments show that compared with the conventional ML algorithm, this algorithm can get more reasonable and feasible analysis results of product image features. If the training set is large, you can increase the value of the class. Then a multi-class classifier is trained for the pictures in the training set, and the word bag of each picture is used as the feature vector, and the category of the picture is used as the label.

Select a picture in a data set and use the directional gradient histogram method to extract features. The purpose of this is to have a general understanding of the dimensions of the obtained feature data, so as to determine the relevant parameters of the directional gradient histogram features. According to the data structure and data type selected in this article, the parameters can be designed as follows: window parameters 64*128, block parameters 32*32 and cell unit

parameters 16*16. The test result of image feature detection error of the algorithm is shown in Figure 4.

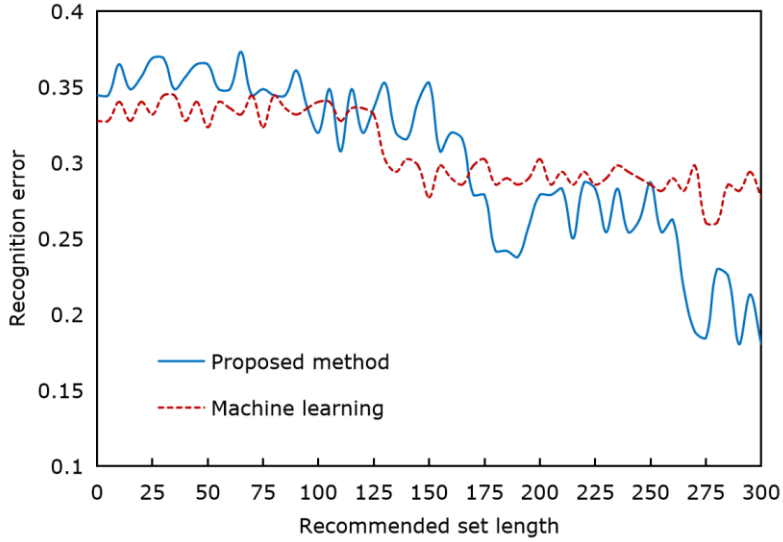

Figure 4: Image feature detection error.

The results show that compared with the traditional ML algorithm, this algorithm has significant advantages in the later stage, and the error rate has decreased by 30.77%. In the structure of CNN, as the gating unit for storing weights, the original image input directly involved in calculation and the output of hidden neurons are both 2D image data. In memory, the memory weight of each pixel is obtained by convolution operation, the memory of each characteristic pixel is realized by Hadamard product, and then the loop function is used for reverse transmission. Figure 5 shows the optimization effect of Wenchuang's product image.

When group consensus is not considered, the evaluation grade of each generation scheme will be determined by the average value of group evaluation, which reflects the distribution and concentration trend of evaluation groups and is easily influenced by the extreme evaluation of user groups. If the optimal individuals of each generation are determined on this basis during population evolution, it will lead to premature convergence of evolution, and a large gap in image preference between evolutionary individuals and user groups. The introduction of consensus model, which takes the consistency and satisfaction of user group evaluation as the constraints of population evolution, is helpful to avoid the phenomenon of users' disagreement. See Figure 6 for the test results of image gray normalization accuracy. The accuracy test results under the condition of uncertain angle are shown in Figure 7.

According to the texture and color characteristics of images, it is an effective way to solve the problems of image segmentation and recognition by using digital image processing technology and improve the HCI experience of product design. From the perspective of image feature visualization, the traditional feature detection method can clearly observe the corresponding feature information on the image, while the DL feature detection method can also observe the image information of the feature in the first few layers of the neural network, but with the deepening of the layers, the image information of the feature will become more and more complex, and it is difficult for human eyes to observe the law.

As a derivative of cultural inheritance and innovation, Wenchuang products have the function of emotional interaction, and can bring consumers a unique cultural interaction experience, which can not only meet people's basic functional needs, but also meet people's emotional needs. Wenchuang products are a spiritual sustenance and a way to release pressure in today's fast-paced and high-pressure era. In the aspect of product interactive design, it can innovate, design

and modify every element of product interactive design, and can carry out some special effects to complete the design scheme.

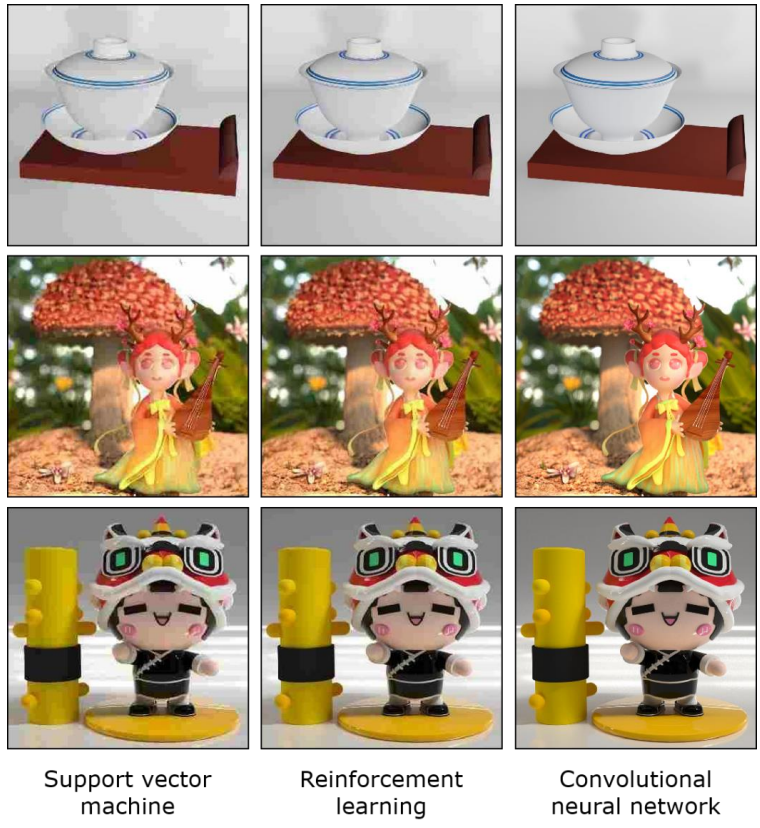

Figure 5: Comparison of image optimization effects of Wenchuang products.

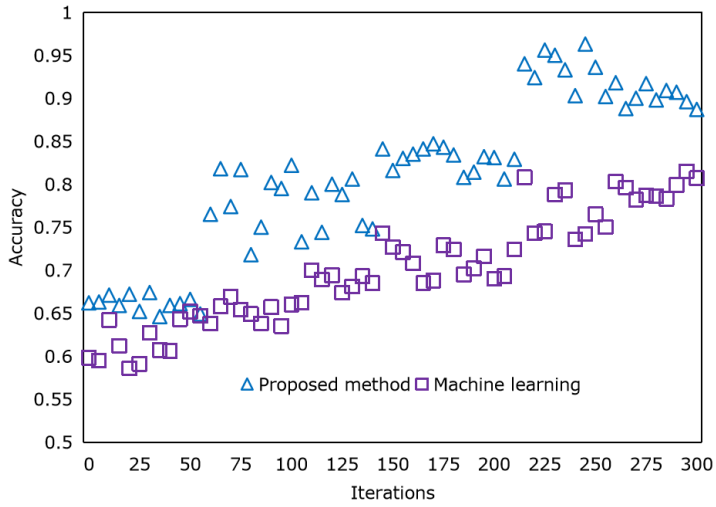

Figure 6: Accuracy of image gray normalization.

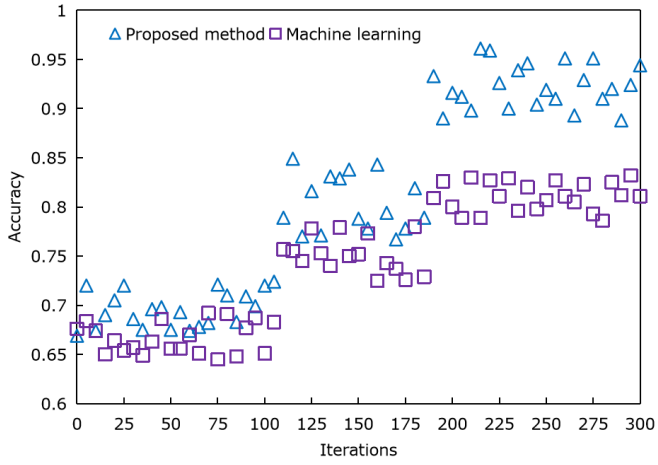

Figure 7: Accuracy under the condition of uncertain angle.

CAD can also output the structural plan of interactive design and the design of packaging interface completely and accurately, which provides great convenience for interactive design of products. For Wenchuang products, interactive design can be used to enhance the brand value and influence of products.

5 CONCLUSIONS

Due to the rapid growth of the computer field and the arrival of the network era, people's demand for image understanding and analysis has further increased, and computer vision has also developed unprecedentedly. In order to make full use of CAD to effectively assist industrial designers in interactive design of Wenchuang products, and output a design scheme that conforms to users' image preferences, a method of extracting image features of Wenchuang products based on DL and CAD is proposed. From the perspective of image feature visualization, the traditional feature detection method can clearly observe the corresponding feature information on the image, while the DL feature detection method can also observe the image information of the feature in the first few layers of the neural network.

How to extract more detailed foreground features and distinguish confusing background information from foreground features is a place that needs further exploration. In order to improve the accuracy and comprehensiveness of defect identification, we can store different types of image feature information when creating defect types and feature databases, so as to make up for the shortcomings. Visual features include texture, color, geometric shape and so on. This article mainly analyzes the surface texture and color features quantitatively, ignoring the information of image geometric shape. In the next further discussion and research, the study of visual surface features can fully combine geometric features to carry out quantitative and targeted experiments.

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