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Computer-Aided Design AND APPLICATIONS

3D Aided Art Design Method Based on Improved Particle Swarm Optimization Algorithm

Jianzhao Sun[1] and Xiaogang Chen[2]

[1]School of Computer Engineering, Henan Institute of Economics and Trade, ZhengZhou 450018, China, jzsun@henetc.edu.cn
[2]School of Computer Engineering, Henan Institute of Economics and Trade, ZhengZhou 450018, China, chenxg@henetc.edu.cn

Corresponding author: Jianzhao Sun, jzsun@henetc.edu.cn

Abstract. Computer-aided design (CAD) has been applied more and more in the field of art design, which has become an indispensable tool for art designers, and art design has also ushered in a new development opportunity. Artificial intelligence (AI) is widely used in art design, which can better interpret the designer's interpretation of works and their design concepts artistically and present them to people. In this article, the characteristics of color images of artworks are analyzed, and a deep learning (DL) model based on improved particle swarm optimization (PSO) algorithm is used to track and extract the contours of artworks, so as to realize the recognition of color characteristics, and the CAD 3D reconstruction of artworks is completed according to the recognition results. The comprehensive results show that this method not only improves the efficiency of artistic image processing compared with the traditional DL method, but also has obvious advantages in image recognition accuracy. Therefore, the improved PSO algorithm is used to optimize the CAD modeling stage of artworks, which can locate the edge contour of artworks relatively accurately on the premise of ensuring the clarity of artworks images, thus improving the efficiency of artistic design and expanding the artistic design ideas.

Keywords: Art Design; CAD; Artificial Intelligence; Particle Swarm Optimization
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1 INTRODUCTION

In the 21st century, mankind has entered the information age, which is based on the platform of electronic computers. Science and technology have greatly promoted the progress and growth of society, and its influence in the field of art design is also enormous. Akilan et al. [1] conducted pixel level deep learning image classification processing. Establish a 3D CNN-LSTM based model that accepts the input image and its corresponding foreground mask, and outputs a segmented image where the foreground area is correctly segmented. Use the training dataset to train the

model, and use the Backpropagation and optimization algorithm (such as gradient descent or Adam) to update the weight and bias of the model. An independent validation dataset is used to evaluate the performance of the model, and the image in the validation dataset and its corresponding real foreground mask are used to calculate the error and Loss function. Then, an optimization algorithm (such as Cross entropy) can be used to optimize the model parameters to minimize the Loss function. It depicted the temporal information regions of image objects at different frame rates, fused the decoder sampled images of the image strategy with each other, and completed the analysis and fusion of the standard indicator dataset of the generalized object confidence map. By controlling the clue path under the time model, it constructs a dual encoding threshold for automatic recognition, improving the performance of the model's competitiveness. Due to the rapid growth of computer software and hardware technology, computer-aided art design has been widely valued and applied because of its advantages of accuracy, authenticity, convenience for preservation and modification, and ability to inspire designers' creative inspiration. Bansal et al. [2] Mutual visual quality protection of digital watermarking algorithms. It analyzes the hybrid image algorithm based on logic and Particle swarm optimization. Through the analysis of the particle swarm optimization scheme of the watermark Grayscale, the sensitivity pursuit of the algorithm image is constructed. For Grayscale, the gray-scale value is used for normalization, and the pixel value is mapped to the range of [0, 255]. For color images, convert the image into the YCbCr color space and process only the brightness channel (Y). Segmenting the preprocessed image into multiple small blocks. The size of each small block can be fixed or adaptively adjusted according to the image size. Evaluate the performance and robustness of image watermarking schemes using validation datasets. Different evaluation indicators can be used, such as Mean squared error (MSE), peak signal to noise ratio (PSNR), etc. Use the trained model to embed watermarks in new images. Input a new image into the model, and the model will output an image embedded with a watermark. By using a multi-scale fuzzy PSO watermarking scheme, the security and integrity of digital images can be effectively protected. This scheme can be applied to various multimedia tools and applications, such as image copyright protection, digital signature, authentication, etc. Judging from the practical effect of computer-aided art, its development prospect is considerable, which provides art designers with efficient, full and all-round new technical means and creates visual effects incomparable to traditional art design. Cedillo et al. [3] conducted quality visual analysis of image signal processing. By hiding key parameters from the scene dataset, a robust Fourier transform watermarking algorithm under diffusion frequency was constructed. This algorithm improves the performance of common color image visual distortion and image watermark changes. Establish a DCT based image watermarking algorithm that performs Discrete Cosine Transform (DCT) on the original image and embeds the watermark information into the DCT coefficients. Particle swarm optimization algorithm is used to optimize the parameters of the above image watermarking algorithm. Particle swarm optimization algorithm is a process of finding the optimal solution by simulating the interaction between particles. it can be used to optimize the embedding strength, embedding position and other parameters to improve the performance of image watermarking. Train the model using a training dataset and evaluate the performance and accuracy of the model using a validation dataset. Use the trained model to embed watermarks in new images. Input a new image into the model, and the model will output an image embedded with a watermark. Ding et al. [4] conducted a pattern design language expression pattern analysis for traditional shapes. By using shape grammar rules, new works of art can be generated. This process can be achieved through programming or manual operation. The generated new artwork can serve as a reusable object or as a foundation for optimization. For the generated new artwork, optimization algorithms can be used for further optimization. Optimization algorithms can include genetic algorithm, Particle swarm optimization algorithm, etc. These algorithms can optimize the shape, color, texture, and other aspects of art works to achieve better visual effects and artistic value. In the design and optimization methods of art reuse based on improved shape syntax, art reuse is very important. By reusing existing art works, it can save creation time and costs, while also achieving better artistic effects. By changing, combining, and optimizing the shape of existing art works, new artistic effects and creativity can be generated.

Digitalization of works of art is to process the accurate digital data of works of art by means of current digital technology, and obtain the data that can be stored in the computer by scanning some excellent works of art, thus realizing the virtual digitization of works of art. Computer-aided art design has become a brand-new artistic design expression means with excellent development prospects, which provides a brand-new artistic expression form for designers and brings profound changes in artistic design aesthetics and artistic design thinking. 3D images contain abundant data information, and it has the advantages of high modeling efficiency and realistic effect to reconstruct 3D models and render them. CAD modeling technology based on artistic images is an important issue in the field of artistic design and computer image research.

Earnshaw et al. [5] conducted an analysis of the progress of digital media research on computers. It constructs the development and cooperation process of Digital art under the virtual environment. CAD virtual reality technology provides artists with a more immersive creative environment. Artists can create scenes and effects that cannot be achieved in real life in the virtual world, and collaborative creation in the virtual world can help artists achieve a more efficient and collaborative creative process. Artists can collaborate with other artists through online collaboration tools or multiplayer interactive features in the virtual world, share ideas and experiences, and create more diverse and diverse artworks. The digital replication and dissemination technology in the virtual world provides artists with a more convenient and extensive display and dissemination platform. Artists can communicate their works to more people through the internet and digital media, and also use digital replication technology in the virtual world to allow more people to experience their artistic works. Harry and Kumar [6] conducted a transformation in the spatial construction method of architectural art design. With the development of digital design tools, architects and designers can use virtual design studios for digital design and modeling. This digital tool can provide more flexible and precise design methods, while also facilitating communication and sharing of design concepts. Virtual reality technology can provide architects and designers with an immersive virtual design environment. In this environment, they can use virtual reality devices for design and evaluation, simulating the real effects of buildings and spaces. This technology can improve the accuracy and efficiency of design, while also reducing costs and risks. Virtual design studios can support collaboration and sharing among multiple architects and designers. They can collaborate on design, data sharing, and synchronization through online collaborative tools or virtual reality technology. This collaborative approach can improve team collaboration efficiency and promote design innovation and development. Due to the rapid growth of computer technology, computers have penetrated into all aspects of real life, because they can conveniently and quickly realize designers' design ideas. CAD has opened up a new design field, and the application of graphic technology in art design provides a brand-new artistic expression for designers, shortening the distance between designers' creativity and design works. According to the real images of artworks, it is of great significance to realize the real reproduction of artworks through 3D modeling, which is of great significance to the network display of artworks and the innovation of cultural and artistic design methods. Compared with the traditional single art design, computer-aided art design is faster and more diverse, which is also the inevitable result of art design advancing with the times. The optimization of CAD modeling mainly discusses which method is the best and how to find the best method. Its goal is to find a set of parameter values under certain constraints, so that some performance indexes of the system can reach the maximum or minimum. Considering that similar works of art have roughly the same topological structure, it is of practical significance to extract the parameters of works of art from real images and realize the 3D parametric modeling of works of art with realism. In this article, the application of improved PSO algorithm in art CAD modeling is studied, and an optimized color feature recognition model of art images is constructed.

In terms of design aesthetics and design thinking, the application of computer graphics technology has a profound impact. From the perspective of exhibition, appreciation and research, the planarization of 3D patterns can get rid of the limitations of regions and media, which is more convenient for viewers and scholars and provides materials for researchers and designers. The application of computer graphic design will gradually affect people's re-cognition of design, and

then form a new aesthetic consciousness of design and a new way of design thinking. This kind of representation of virtual space, which is so close to the real space effect, is difficult to achieve by other means of expression. The focus of art design development in the new era will be AI. Analyzing the use of AI in art design can help us better understand the development direction of AI. The artistic design completed by AI can effectively convey the design intention that designers want to express and truly show the connotation of artistic works. This article studies the application of AI in computer-aided art design, and makes the following innovations:

(1) In the global optimization problem, PSO algorithm can show good performance in both convergence speed and global optimization ability. Therefore, this study uses the improved PSO algorithm to solve the color recognition problem of multi-threshold artistic images.

(2) The paper studies how to extract and identify the color features of art images by improving the DL model of PSO, so as to optimize the modeling stage of art CAD, improve the efficiency of art design and expand the ideas of art design.

Firstly, this article expounds the idea of applying PSO algorithm in AI to CAD modeling of works of art; Then in the method part, the optimization stage of art image processing and art design CAD modeling is analyzed. Then the application of the algorithm in artistic image processing and CAD modeling is compared by using standard test images and data sets.

2 RELATED WORK

The optimal band selection for hyperspectral images is an important task that can be achieved through derivative based band clustering and multi-agent PSO optimization. Kalidindi et al. [7] conducted an analysis of key factors in unsupervised selection of frequency bands for images. Perform derivative calculations on each band of the hyperspectral image to obtain its variation. This can be achieved by performing first-order or higher-order derivative calculations on each band. Cluster similar bands together based on the derivative calculation results. Clustering algorithms such as k-means clustering or Hierarchical clustering can be used to cluster bands. Use multi-agent PSO algorithm to optimize the results of band clustering. Multi agent PSO algorithm is an optimization algorithm based on Swarm intelligence, which seeks the optimal solution by simulating the interaction between multiple agents. Based on the optimization results, select the optimal band combination to achieve the best hyperspectral image effect. By using derivative based band clustering and multi-agent PSO optimization, the optimal band of hyperspectral images can be effectively selected, thereby improving image quality and recognition performance. Karnchanapayap and Chaetnalao [8] conducted creative sensory art construction of artwork through the carving of elements in artistic digital media. It innovates and develops virtual world art through simulation analysis for learning experience. Virtual reality art can break the limitations of time and space, allowing users to experience and explore Buddhist culture anytime and anywhere. Virtual reality art, as an innovative Buddhist learning tool, can help users better understand and experience Buddhist culture, improve their cultural literacy and moral level. At the same time, virtual reality art can also provide a new approach and method for Buddhist education, making positive contributions to the inheritance and development of Buddhist culture. Meinecke et al. [9] explored and analyzed the visual elements of virtual museum. It constructs a filter style exploration for similarity interactive reality visualization of image detection. By analyzing the image archives of art elements from different perspectives, the virtual scheme experience in public places has been enhanced. In the virtual museum, the audience can interact with the works of art through interactive visualization technology. For example, an interactive interface can be designed to allow the audience to zoom in, out, and rotate the artwork through clicking, dragging, and sliding operations, in order to appreciate the details and characteristics of the artwork in greater detail. The virtual museum can restore the original scene of art works through interactive visualization technology, such as the artist's studio, creation scene, etc. Viewers can enter these scenes through virtual reality devices to understand the background and process of artistic creation, thereby gaining a deeper understanding of the meaning and value of artistic works. The

virtual museum can arrange and display the art works according to the historical timeline through interactive visualization technology. Viewers can browse the development process of art works in chronological order by sliding or dragging the timeline, thereby gaining a more comprehensive understanding of the development and evolution of art. Virtual reality technology can provide real-time feedback and adjustments for students or designers, thereby helping them better achieve artistic creation. For example, students or designers can view their works in real-time in a virtual environment and adjust and optimize them based on feedback, in order to better realize their artistic impulses. Virtual reality technology can enable students or designers to better experience and interact with their artistic works. In virtual reality, students or designers can immerse themselves in their works and engage in deeper exploration and experience, thereby further stimulating their artistic impulses. Virtual reality technology can provide students or designers with a brand new and immersive artistic creation environment, thereby stimulating their creative inspiration, providing rich creative materials, supporting collaborative creation, providing real-time feedback, and promoting interaction and experience. Ornes [10] uses virtual reality technology to enable students or designers to better fulfill their artistic impulses and create more unique and diverse works of art.

Pallasena et al. [11] conducted visual development to immersively control the intersection of 3D model elements. It combines high-quality visual product AR experience to develop and design visual and voice cues. In AR design, interaction refers to the interaction between users and virtual objects. Through augmented reality technology, users can interact with virtual objects, such as Gesture recognition, voice recognition, etc. The design of interaction needs to consider the user's operating mode, the reaction of virtual objects, and the logic of interaction. Good Interaction design can provide a more natural, intuitive and interesting experience. Visual canvas refers to the presentation of virtual images in AR systems. The visual canvas needs to consider the size, position, color, transparency, etc. of the virtual image. When designing a visual canvas, it is necessary to consider the user's perspective and visual habits, as well as the coordination between virtual images and the real environment. Pillai et al. [12] analyzed and discussed the visual simulation analysis construction of 3D printing technology in dentistry. It explores the spatial structure model of teeth based on computer virtual environment. Through virtual spatial structure calculations, it developed a process assisted design process for tactile simulators. For the generated new artwork, optimization algorithms can be used for further optimization. Optimization algorithms can include genetic algorithm, Particle swarm optimization algorithm, etc. These algorithms can optimize the shape, color, texture, and other aspects of art works to achieve better visual effects and artistic value. In the design and optimization methods of art reuse based on improved shape syntax, art reuse is very important. By reusing existing art works, it can save creation time and costs, while also achieving better artistic effects. By changing, combining, and optimizing the shape of existing art works, new artistic effects and creativity can be generated. Rarenko [13] carried out the detection and analysis of Computer graphics 3D advertising graphics design. It constructs a visual brand communication classification and graphic quality definition analysis for 3D graphics. Animated 3D graphics can be used to create television advertisements to convey information about products or services to the audience. By using 3D graphics to present the characteristics and advantages of the product, the visual effect of the advertisement can be enhanced, attracting the attention of the audience, and improving the communication effect of the advertisement. Animated 3D graphics can be combined with virtual reality technology to provide viewers with an immersive brand experience. By creating virtual reality scenes, viewers can experience the brand's world firsthand, enhancing the emotional connection between the brand and the audience. Through the use of 3D graphics, the characteristics and style of the brand can be presented in a Visualization way to improve brand awareness and visual influence. Overall, animated 3D graphics have important application value in visual brand communication on television. Through the use of 3D graphics, the brand can be presented to the audience in a more vivid, Visualization and consistent way, enhancing the brand's recognition and visual influence. This innovative brand communication method can bring more attention and recognition to the brand, and promote the enhancement of brand value.

Song et al. [14] conducted a Background check on educational design of digital manufacturing, and its construction analyzed product manufacturing in the field of artificial intelligence. Digital manufacturing technology can help students create art works of various materials, such as plastic, metal, ceramics, etc. Students can convert their designs into physical artworks through 3D printing technology, or achieve artistic creation through technologies such as CNC engraving. Digital manufacturing technology can be combined with virtual reality and augmented reality technologies to provide students with a more immersive artistic experience. Students can create art in a virtual environment and convert virtual works into physical artworks through digital manufacturing technology. Digital manufacturing technology can help students visualize data. For example, students can use 3D drawing software to draw design drawings of artworks and convert them into solid models through digital manufacturing technology. Wang and Hu [15] have integrated 3D virtual technology reality into traditional art environments. It constructs a reference index for 3D virtual environmental art virtual restoration. Environmental art design usually requires drawing a large number of drawings and models. CAD (Computer-aided design) software can help students or designers quickly draw plans, elevations, sections, etc., and can carry out accurate size and scale control. 3D modeling is a very important aspect in environmental art design. Establishing 3D models through CAD software can help students or designers better understand the appearance and structure of design schemes, and can be simulated and optimized in virtual spaces. Environmental art design usually requires processing a large amount of data and information. CAD software can help students or designers visualize data, such as displaying and communicating through charts, images, and other means. Environmental art design typically requires collaboration and collaboration among multiple students or designers. CAD software can support multiple individuals to design simultaneously, and can share and synchronize data, improving team collaboration efficiency. Xia et al. [16] analyzed and constructed a robust architecture for geometric pose sensing based on image features. Through semantic navigation analysis of 3D spatial image mapping, it has constructed a multi-scale mapping network semantic fusion standard. Visual simultaneous localization and mapping based on image semantics is an important technology in autonomous navigation of mobile robots. It obtains environmental images through the camera equipped with the robot, and combines image processing and machine learning algorithms to achieve accurate perception of the robot's own position and accurate mapping of the environment. SLAM technology can achieve precise perception of the robot's own position and accurate mapping of the environment through image processing and machine learning algorithms. By processing and analyzing the environment image, the robot can build a map and determine its position in the map. SLAM technology based on image semantics can provide accurate environmental maps, which can provide a foundation for robot path planning. Robots can plan the optimal path and achieve autonomous navigation through maps and their own location information. Zhao et al. [17] conducted the digital management construction of VR 3D model construction using virtual reality technology. It analyzes the artistic value of virtual reality mobile image design in the era of new media economy. In virtual reality, digital media can be used to enhance the display effect. For example, annotations, audio, video, etc. can be added to the digital model of the exhibition, allowing the audience to have a deeper understanding of the background and history of the exhibition. Virtual reality technology can also provide more interesting navigation services. The audience can conduct virtual tour in the museum through virtual reality equipment, and understand the detailed information and historical background of exhibits through digital media and Interaction design. Exhibits and scenes in virtual reality can be updated and adjusted at any time to maintain the timeliness and updating of the display. At the same time, the virtual display content can be adjusted and replaced according to different exhibition themes.

3 COMPUTER 3D AIDED ART DESIGN OPTIMIZATION

3.1 Art Image Processing and Color Feature Extraction

Art image processing is a broad concept that involves multiple methods and technologies. Among them, color feature extraction is a commonly used method that can help us better understand and process artistic images. Color histograms can reflect the frequency of each color appearing in an image. You can obtain a color histogram by calculating the color values of each pixel in the image and then counting the number of occurrences of different colors in the image. Color moment is a feature extraction method based on gray distribution, which can be used to extract low - and high-order features in images. The first moment can reflect the brightness distribution of the image, the second moment can reflect the contrast of the image, and the third moment can reflect the texture information of the image. Color transfer is a method of converting the color space of an image, which maps the colors in the image to another color space. Common color transfer methods include HSV color space, LAB color space, and YUV color space. Color clustering is a method of clustering colors in an image, which can group similar colors together to obtain a representative set of colors. Color clustering can be implemented using clustering algorithms such as k-means clustering or Hierarchical clustering. Color saturation is a feature that reflects the purity and brightness of colors in an image. The color saturation characteristics of an image can be obtained by calculating the color values of each pixel in the image and then calculating the saturation of different colors. In art image processing, color feature extraction can be used for various applications, such as image retrieval, classification, and recognition. At the same time, different color feature extraction methods can also be combined to obtain richer image features and better processing results.

With the strong growth of AI, designers can use a lot of design software to realize their inspiration. Compared with the traditional artistic design that lasts for months or even years, the use of computers can help designers to finish their creations quickly and effectively and produce a large number of molds. Considering that similar works of art have roughly the same topological structure, it is of practical significance to extract the parameters of works of art from real images and realize realistic 3D parametric modeling of works of art. After the design of a work is completed, the designer can not only grasp the specific size of the object, but also easily analyze the visual feeling of the picture from different angles. This systematic process design not only saves working time, but also designs works of art more scientifically. In the past, designers paid great attention to modeling design and paid attention to the novelty and novelty of modeling. However, with the development and perfection of works of art, color has also been applied in it, and designers began to realize that only by coordinating color and modeling can artistic design works be both in form and spirit, so that viewers can better understand the design theme of works of art. The stage of color feature extraction of artistic images is shown in Figure 1.

The images in the art image database are basically unchanged and stored in the image database for a long time, and the number of images stored is also relatively large. In order to increase the speed of image feature recognition, DL model can be used to pre-extract the features of images, and all the images in the image database can be extracted and stored in the model. The standardized optimal index set is used as the reference data column, and the standardized index value $(y_{i1}, y_{i2}, y_{i3}, \ldots, y_{im})$ $(i = 1,2,3,\ldots,n)$ is used as the compared data column. Then use the following formula to calculate the grey correlation coefficient:

$$\delta_i(j) = \frac{\min\limits_i \min\limits_j \left|s_j - y_{ij}\right| + \rho \max\limits_i \max\limits_j \left|s_j - y_{ij}\right|}{\left|s_j - y_{ij}\right| + \rho \max\limits_i \max\limits_j \left|s_j - y_{ij}\right|} \tag{1}$$

Where $\delta_i(j)$ is the correlation coefficient between the j index of the i sample and the j optimal index value in the optimal index set; ρ is the resolution coefficient, which is generally taken as 0.5. So, the grey assessment matrix is obtained:

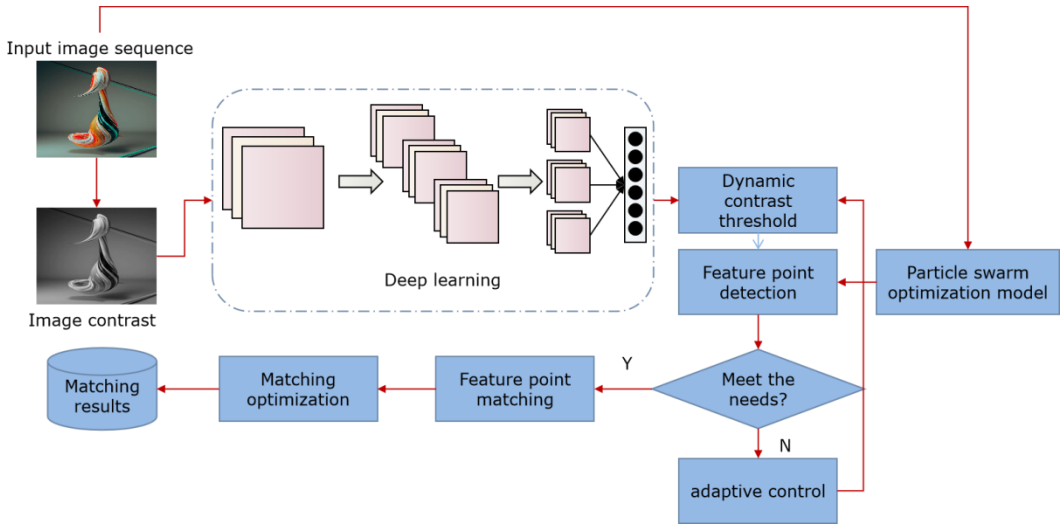

Figure 1: Color feature extraction stage of art images.

$$E=\begin{bmatrix} \delta_1(1) & \delta_1(2) & \cdots & \delta_1(m) \\ \delta_2(1) & \delta_2(2) & \cdots & \delta_2(m) \\ \cdots & \cdots & \cdots & \cdots \\ \delta_n(1) & \delta_n(2) & \cdots & \delta_n(m) \end{bmatrix} \tag{2}$$

The correlation degree between comparison series and reference series is expressed by correlation degree, and the calculation formula is as follows:

$$\gamma_{0i}=\frac{1}{n}\sum_{k=1}^{n}\gamma_{0i}(k) \tag{3}$$

Where $\gamma_{0i}(k)$ is the correlation degree, that is, the average of the correlation coefficients of the same factor.

Classify the collected product samples and get a certain amount of product samples by removing the close ones. These initial samples are grouped to select representative samples, and the representative samples are modeled by CAD software.

3.2 Optimization of Art Design CAD Modeling Based on Improved PSO

For humans, complex and diverse patterns are easier to distinguish, but for computers, the higher the complexity of patterns, the greater the amount of calculation, so it is necessary to quote an extraction method sensitive to image features. The deeper the convolutional neural network (CNN) is, the more sensitive it is to image details. Therefore, the image feature extraction in CNN should go deep into the network. Convolution nuclear energy convolves images of any size, transforming the shallow features of images into deep convolution features, that is, transforming the original RGB space of images into deep semantic space. The steps of improving PSO are shown in Figure 2.

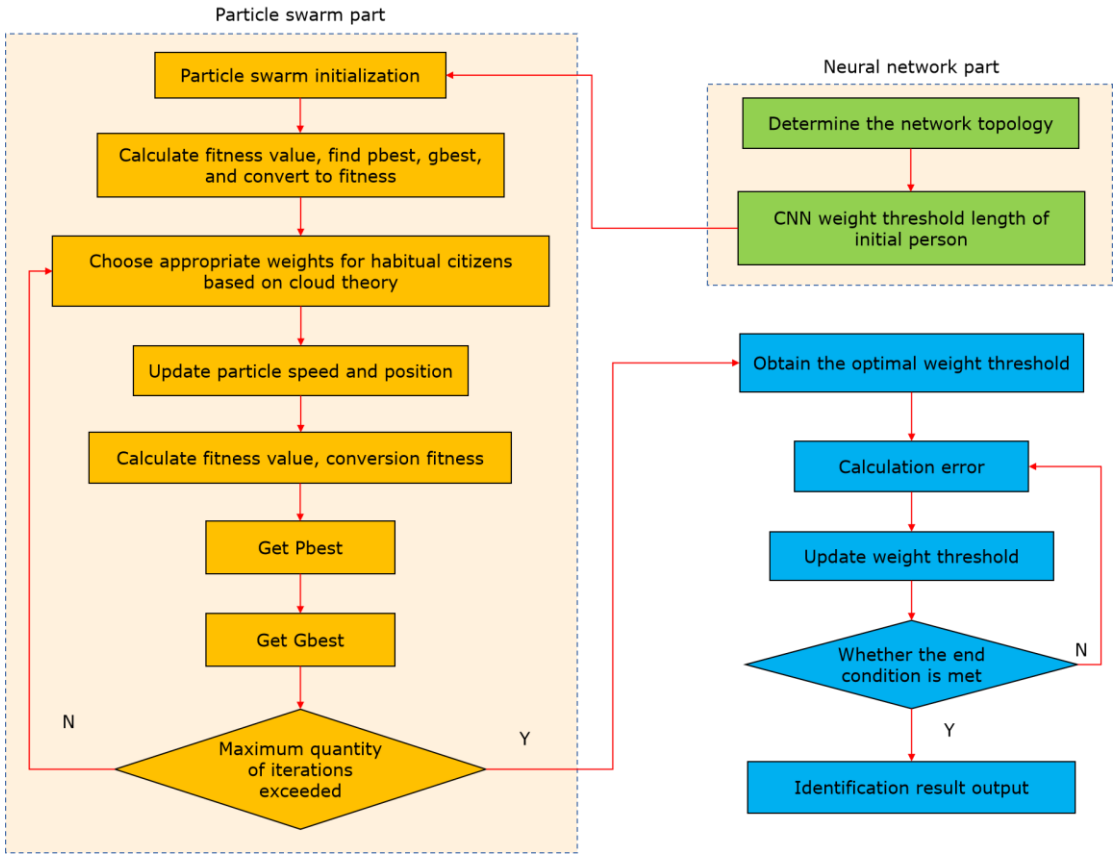

Figure 2: Steps for improving PSO.

For particle swarm, each potential solution can be represented by a particle with neither volume nor mass. Particle optimization is similar to a predation stage of birds. The relationship between birds' mutual judgment of food position and search is transformed into actions between particles, and all particles can carry out optimization activities in a specified optimization space at a certain speed. For the population, other evolutionary methods are all a survival rule, which can ensure the best quality of the whole population. Each particle has its own current velocity, which is recorded as:

$$V_i = \{V_{i1}, V_{i2}, \ldots, V_{il}\} \tag{4}$$

Remember Xbest(t) as the optimal position experienced by the current particle swarm, that is, the particle with the best fitness. Each particle updates its speed according to the following formula:

$$V_k^d(t+1) = V_k^d(t) + c \cdot rand \cdot \left(X_{best}^d(t) - X_k^d(t)\right) \tag{5}$$

Where $V_k^d(t+1)$ is the velocity component of the d feature after the k particle is updated; l is the characteristic number of the solution; $X_{best}^d(t)$ is the component of the d feature of the currently searched optimal solution; $X_k^d(t)$ is the d characteristic component of the current

position of the k particle; c is a constant; $rand$ is a random number between $(0,1)$. Each particle updates its position according to the following formula:

$$X_k^d(t+1) = X_k^d(t) + V_k^d(t+1) \tag{6}$$

Where $X_k^d(t+1)$ represents the d feature component after the k particle updates its position.

Each particle of PSO algorithm is a part of the population, and they all fly at a certain speed in space to find the optimal solution. Each particle does not occupy volume and its weight is neglected, and its speed will change with the accumulation of flight experience or self-learning of the whole particle swarm during flight. For the algorithm, the connection between particles in the particle population constitutes the neighborhood topology of particles. Neighborhood topology determines the transmission mode of individual optimal position information in the whole population, which also determines the performance of the algorithm. If the information transmission intensity of the optimal position is too large or too fast, the influence of the current optimal position on the whole particle population will be enhanced, leading to premature phenomenon. The principle of PSO-CNN is shown in Figure 3.

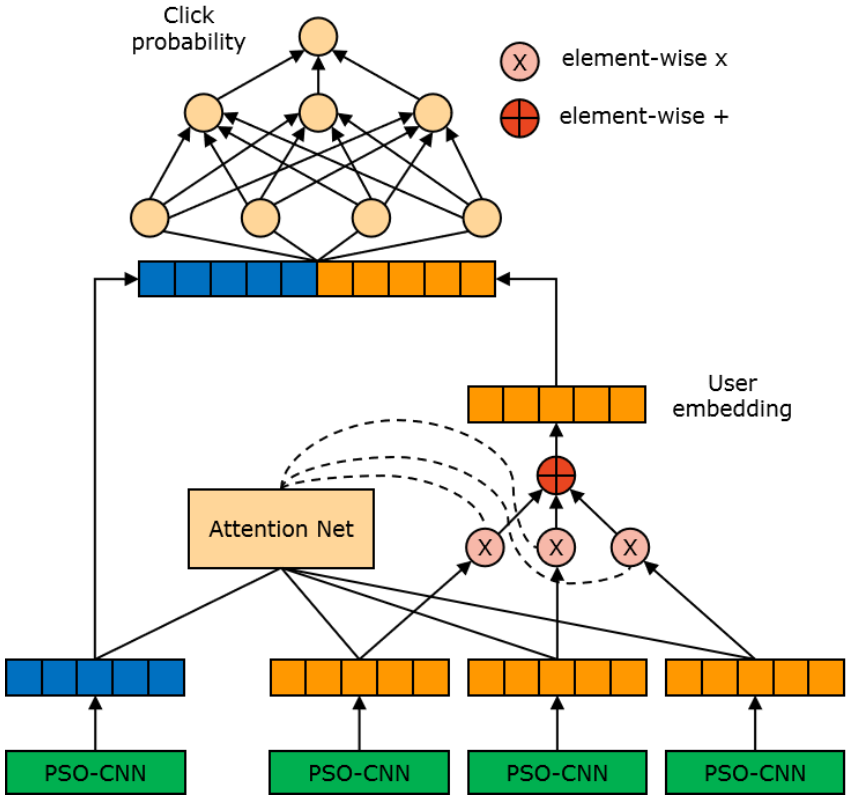

Figure 3: PSO-CNN principle.

Contour tracking is only valid for continuous boundaries, and it should be repeated if discontinuous boundaries appear. According to this tracking algorithm, the image contour is tracked continuously, and the coordinates of each contour point are recorded, and the contour points are increased by 1. The coordinates of boundary points are stored in a point coordinate array, and the sequence of point coordinates is stored in the tracking order. After each segment is tracked, the

number of segments is increased by 1, and the points of the segment are recorded until all contour points are tracked.

In the stage of generating offspring subgroups from parent subgroups, evolution is the main factor, so the strategic bias at this level is called evolutionary strategic bias; In the stage of generating new parent subgroups from offspring subgroups, competition is the main factor, and the corresponding strategic bias is called competitive strategic bias. It is through the cooperation and competition between subgroups and particles that the whole population is promoted to move in the optimal direction.

In the 3D modeling of computer-aided art design, set the normal vector of each triangle in the related triangle group of vertex v_i as n_k, the center as x_k, and the area as a_k. Then, the plane formed by the normal vector and the center defined by the following is called the average plane of this vertex:

$$N = \frac{\sum n_k a_k}{\sum a_k} \tag{7}$$

$$n = \frac{N}{|N|} \tag{8}$$

The offset from point P to grid model TM in 3D space is defined as:

$$d(P, TM) = \min\left(d(P, X)\right) \tag{9}$$

Where $d(P, X)$ is the Euclidean distance from point P to point X. For vertex P, there are k triangles around it. Let the unit normal vector of the i th triangle be:

$$n_i \quad (i = 1,2,3,\ldots,k) \tag{10}$$

Define the normal vector of vertex P as the average of the normal vectors of all the triangles around it, and use n_p to represent the normal vector of vertex P, then:

$$n_p = \frac{1}{k}\sum_{i=1}^{k} n_i \tag{11}$$

Normalize it:

$$n_p = n_p / |n_p| = \frac{n_{px}\vec{i} + n_{py}\vec{j} + n_{pz}\vec{k}}{\sqrt{(n_{px})^2 + (n_{py})^2 + (n_{pz})^2}} \tag{12}$$

If the selection range is narrowed near the historical optimal position, the speed of finding the global optimal solution can be much faster. The PSO algorithm based on iterative equation is based on this theory to optimize the particle swarm, and this better idea of the algorithm can be used in the speedless PSO algorithm, so that the performance of the speedless PSO algorithm can be improved as a whole.

4 RESULT ANALYSIS AND DISCUSSION

Under the background of the rapid growth of contemporary society, if designers want to design better works, conform to the growth of the times and embody their own artistic design concepts and styles, they should reasonably apply AI to artistic design and give full play to the value of AI. PSO algorithm is an AI algorithm, which has many advantages compared with many other evolutions, such as simplicity, few parameters and rapid convergence. The application of the

algorithm in artistic image processing and CAD modeling is compared by using standard test images and data sets. Through experiments and analysis, the practicability of the proposed artistic image modeling method is proved. In the experiment, the operating efficiency of artistic images of different scales with different nodes is analyzed. Figure 4 shows the test results.

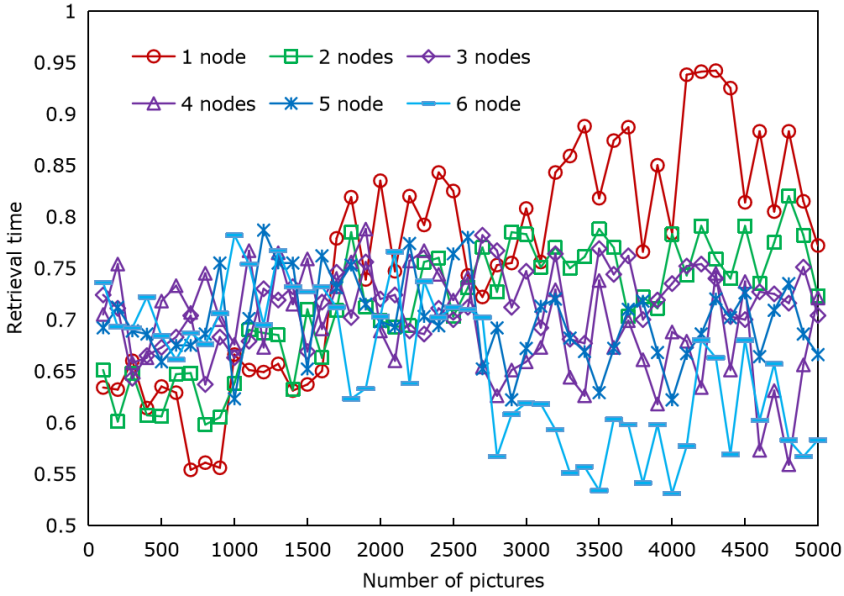

Figure 4: Time consumption of image recognition under different number of nodes.

In the case of a small artistic image, with the increase of nodes in the image, the time required for image recognition also increases. When the image scale becomes larger and larger, the recognition efficiency of multi-nodes will show an obvious upward trend.

In order to quickly and accurately search for the optimal threshold combination of multiple thresholds and make the image segmentation result more accurate, the improved PSO algorithm is applied to the selection of multiple thresholds in image segmentation, which can quickly find the optimal threshold combination of multiple thresholds that makes the segmentation result accurate, and is suitable for complex images with multi-peak histograms. The time-consuming of the improved PSO method and the traditional DL model for artistic image processing is shown in Figure 5.

As can be seen from the figure, the traditional DL method takes longer to digitize artistic images. The degree of strategy bias is best expressed by the role played by a strategy in the whole evolution stage of the subgroup, but it is often difficult to quantify, so a simple but possibly unreasonable calculation method is to express it by the proportion of particles adopting a strategy in the whole subgroup. At different stages in the evolution process, the strategy set may be an evolutionary strategy set or a competitive strategy set. At the beginning of evolution, when the offspring sub-cluster is generated by the parent through evolution, evolution dominates, and the strategy set is correspondingly called the evolutionary strategy set. What the strategies in the evolutionary strategy set need to ensure is that they can produce offspring subgroups with high fitness as much as possible.

The sub-group runs the optimization iteration process under the current parameter configuration, and outputs the optimization result to the super group. The super group judges this output value. If the set optimization threshold is not met, the super group uses this value as a

basis to adjust the parameter configuration of the sub-group, and then the sub-group performs a new optimization iteration process according to the adjusted parameters until the problem is finally solved. Figure 6 shows the image recognition accuracy test of the improved PSO method and the traditional DL model.

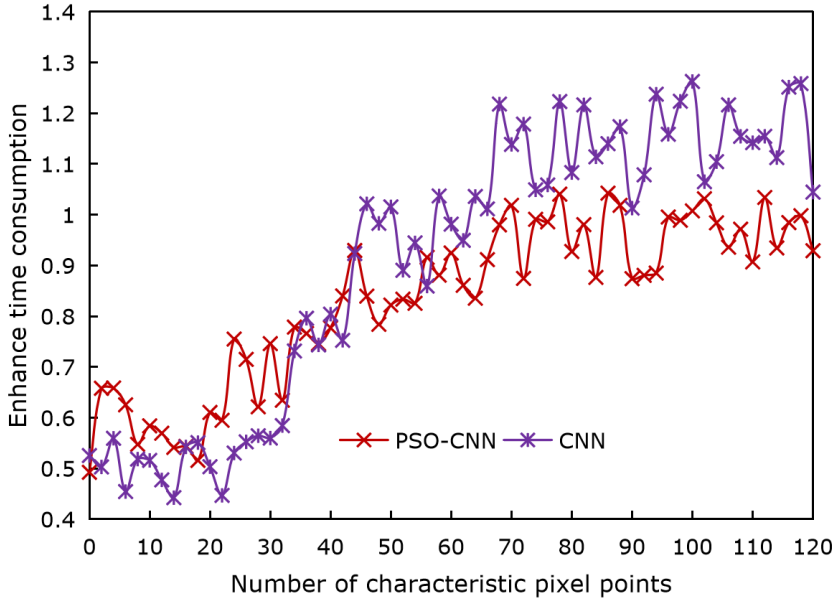

Figure 5: Time-consuming test of image recognition processing.

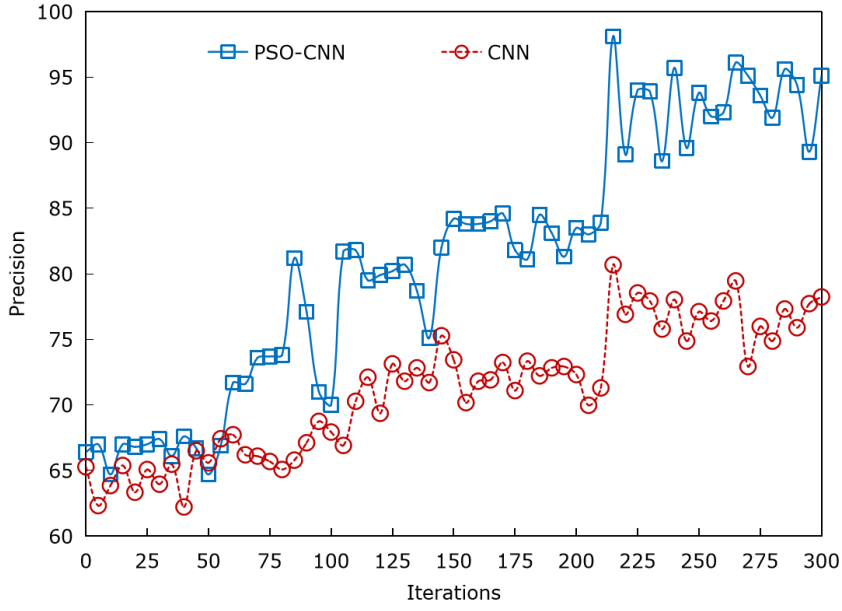

Figure 6: Accuracy results of different algorithms.

If the image is enhanced before registration, the features of feature points in the image will be enhanced and the registration accuracy will be increased. As can be seen from Figure 6, the accuracy of this algorithm is improved by about 20% compared with that of traditional CNN.

When the algorithm starts to run, each particle in the particle population takes itself as a neighborhood, and with the operation of the algorithm, the neighborhood range of particles is continuously increased until the whole particle population. Compare the recall of the algorithm for art image recognition, as shown in Figure 7.

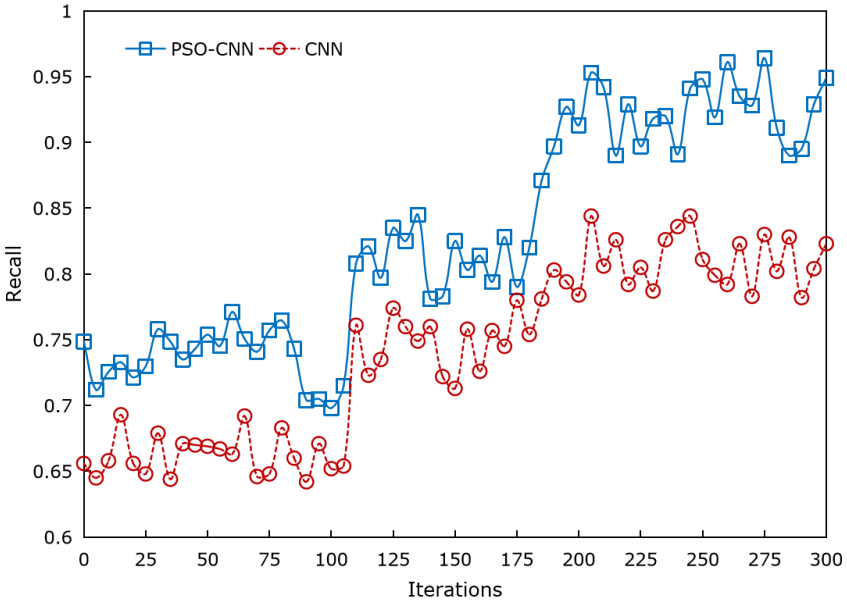

Figure 7: Comparison of recall of artwork image recognition.

The test results show that the recall of this algorithm for art image recognition has increased by more than 15%. The comprehensive results show that this method not only improves the efficiency of artistic image processing compared with the traditional DL method, but also has obvious advantages in image recognition accuracy. Therefore, using the modified PSO algorithm to optimize the CAD modeling of artworks can locate the edge contour of artworks relatively accurately on the premise of ensuring the clarity of artworks images.

Traditional art designers can only establish a series of actual expression effects in their own minds through their own imagination, which lacks the feasibility study based on practice. The application of computer software can create a virtual environment for art designers, introduce all kinds of influencing factors in reality into the virtual environment, and then observe the functions and effects of design products with the help of this virtual environment. This kind of expression technique can not only test the feasibility of the product, but also provide the direction for art designers to modify it. When choosing and matching colors, designers must analyze and study the emotional laws of colors, deeply consider which colors will bring people what kind of visual experience and psychological emotional experience, and effectively grasp the emotional laws brought by colors to ensure the effect of color application and improve the level of color matching of works of art.

5 CONCLUSIONS

The material life of human beings is constantly progressing due to the continuous innovation of design. On the basis of practicality, art design constantly adds its aesthetic artistry, bringing renewal and enjoyment to human life. It is of practical significance to extract the parameters of works of art from real images and realize the 3D parametric modeling of works of art with realism. Analyzing the use of AI in art design can help us better understand the development direction of AI. The DL model based on PSO proposed in this article will be more in line with people's cognitive process, and it is expected to get more accurate prediction results, which will help to narrow the cognitive gap between designers and users on product perceptual images, so as to obtain correct perceptual image information. The artistic design completed by AI can effectively convey the design intention that designers want to express and truly show the connotation of artistic works.

The application of AI in artistic creation is the embodiment that the growth of science and technology benefits the society, and the embodiment that artistic design keeps pace with the times under the growth of the times. For the specific PSO algorithm, when designing the algorithm, a certain balance should be made between the efficiency of the algorithm search and the global convergence. This balance is largely given in the form of algorithm parameters according to experience. How to give the criteria in theory needs further research on the algorithm.

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Jianzhao Sun, https://orcid.org/0000-0002-8374-5790
Xiaogang Chen, https://orcid.org/0000-0002-1052-6167

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