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# The Application of Painting Image Processing Technology in Arts and Crafts Teaching

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**Abstract.** In the growth of art design, in order to conform to the growth trend of the information age, the use of computer-aided design (CAD) is becoming more and more common. CAD technology provides an efficient and accurate design tool for arts and crafts teaching. This article studies the application of CAD and art painting image processing technology in arts and crafts teaching, and proposes the feature extraction of art painting image. This method adopts the framework of adaptive cross-layer correlation, weights the features in different spatial positions according to the intrinsic correlation of features, and encapsulates them into the network. Through end-to-end training, it learns the rich texture information of art painting images, and then realizes the classification of CAD art painting images. Simulation test shows that PSO-CNN method has higher accuracy and efficiency than traditional CAD and art painting image processing technology. This method can not only improve teaching efficiency, but also help learners to better master modern design skills, provide new ideas and directions for the growth of arts and crafts teaching, and improve the efficiency and accuracy of arts and crafts teaching.

**Keywords:** Arts and Crafts Teaching; Fine Arts Painting; Image Processing; CAD
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## 1 INTRODUCTION

After people's material needs are met, they gradually begin to pursue spiritual needs, and art activities have attracted more and more attention. The traditional graphic processing process is: the designer draws the manuscript, the technician sets it out to the actual processing size and the specified process requirements, and then the processor operates it and processes it on the working face where the bottom sample is drawn. This process is mostly done by hand, which is inefficient. Amri et al. [1] proposed an image enhancement method to improve images in turbid water environments. The experimental show that our method can improve the quality of turbid

underwater images. However, our method still has some limitations, such as the effect of image enhancement may be limited for very turbid water bodies. Future research will focus on improving our methods to better adapt to various turbid water bodies. With the continuous development of machine vision technology, its accuracy and reliability continue to improve, enabling automation to complete more complex tasks. This has led to the increasingly widespread application of machine vision technology in industrial production and visual design, becoming an important force driving innovation in related fields. The development of artificial intelligence and big data technology has provided strong support for machine vision. By training a large number of samples, machine learning algorithms can continuously optimize the machine vision system, improve recognition accuracy and processing speed. At the same time, big data technology also provides rich data resources and processing tools for industrial production and visual design. This enables related fields to achieve more accurate prediction and intelligent control. In the growth of art design, in order to conform to the growth trend of the information age, the application of CAD is becoming more and more common. In the past few decades, many researchers have conducted in-depth research on ink painting art. From the drawing techniques and artistic expression of ink painting, to the historical and cultural background of ink painting, rich achievements have been achieved. Research on computer-based ink painting creation has become increasingly rich. Among them, the application of deep learning frameworks and CNN models in ink painting art creation has received widespread attention. Creating ink painting has become possible. The rise of deep learning frameworks and convolutional neural network models (CNN) has provided new ideas and methods for ink painting art creation. Chen [2] explored how to create ink painting art based on deep learning frameworks and CNN models. It is urgent to strengthen the construction of art design education, and the key is to integrate CAD and art design courses. In arts and crafts teaching, educators need to evaluate and guide learners' works. Using image classification technology, learners' works can be classified and evaluated according to their characteristics. Computer assisted arts and crafts refers to a method in the creation of arts and crafts. Since the 1950s, computer-aided arts and crafts have gone through a development process from simplicity to complexity, and from machinery to intelligence. Computer assisted arts and crafts can not only improve the efficiency and quality of arts and crafts creation, but also achieve effects that traditional handicrafts cannot achieve. Arts and crafts is a creative form of art that focuses on handcrafting. Artificial intelligence, as an important branch of computer science, is also playing an increasingly important role in arts and crafts. Deng and Chen [3] analyzed a large number of art works and painting techniques, allowing computer systems to imitate human creative processes and generate artistic images and paintings. There are many different styles and schools in the field of arts and crafts, and learners need to understand and master different style characteristics. Using image classification technology, we can classify different styles of works and analyze their characteristics.

In modern society, CAD and image processing technology of art painting have become important tools for arts and crafts teaching. CAD technology provides an efficient and accurate design tool for arts and crafts teaching. A multidisciplinary field that covers various aspects such as computer science, design art, multimedia technology, and more. In this field, computer-aided design (CAD) and application are two very important parts. Generally speaking, the recognition of I frames can be achieved through specific frame header codes. For example, in the MPEG-2 compression standard, the frame header code of I frames is 0x00001. By identifying the frame header code, the type of each frame can be determined to select the key frame. Guo and Li [4] transform their creativity into works with tactile and visual impact, while also allowing viewers to experience the designer's creativity in a virtual environment. Through CAD software, learners can easily draw geometric figures, edit texts, adjust colors and sizes, etc. In addition, CAD software also provides rich plug-ins and scripting languages, which can easily realize automatic design and mass production. Therefore, the application of CAD technology can not only improve teaching efficiency, but also help learners better master modern design skills. The image processing technology of fine arts painting can provide richer teaching resources and means for arts and crafts teaching. Through image processing technology, educators can easily transform fine arts

paintings into digital images, and edit, analyze and explain them. Moreover, learners can also use image processing software to practice and learn how to adjust parameters such as color, contrast and brightness, so as to better understand the charm and details of works of art. In this article, the application of two technologies in arts and crafts teaching is discussed, and an image feature extraction method based on PSO-CNN is proposed, aiming at improving the efficiency and accuracy of arts and crafts teaching.

Tiktok disorder in strawberry leaves is a common plant disease, which seriously affects the growth and yield of strawberry. Therefore, timely and accurate detection of Tiktok obstacles is of great significance for strawberry planting. Traditional detection methods are usually based on manual observation and statistical analysis, which are not only time-consuming and laborious, but also prone to errors. Artificial intelligence interaction can also help designers better understand their design works. By using natural language processing (NLP) and emotion analysis techniques, artificial intelligence can analyze the creative process and design works of designers, and provide feedback and suggestions. This will help designers better understand their work and how to improve it in future designs. In arts and crafts design, CNN can be used to automatically identify and classify design elements, such as color, shape, texture, etc. Designers can use CNN to help them make decisions in their design, such as selecting the color combinations or shapes that are most suitable for expressing their creativity. Hariri and Avşar [5] discuss the method of using CNN and particle swarm optimization (PSO) algorithm to detect Tiktok obstacles in strawberry leaves. The experiment first preprocesses the original leaf image, including image enhancement, normalization, and cropping operations. Then, we will use CNN to extract features from the image and optimize the parameters of the CNN using the PSO algorithm. Finally, we will classify leaf images based on the optimized CNN model and evaluate the performance of the model. In the early stage of the growth of internet technology, people's understanding, appreciation and learning of artistic images were mainly concentrated in the small art circle around artists, and the diversity of artistic forms and artistic creation techniques were relatively simple. With the popularity of the Internet, the digital display of images based on the Internet has become more and more mainstream, and people can get to know the related art information more quickly and comprehensively. The birth of electronic computers has expanded and extended people's brain intelligence, and its impact on art design and art design education has become more and more significant. However, there are still some problems in the application of existing CAD and art painting image processing technology in arts and crafts teaching. For example, the scripting language of CAD technology is often complicated and difficult for beginners to master; However, the image processing technology of art painting needs to spend a lot of time and energy to manually adjust the parameters. The PSO-CNN model adopts the framework of adaptive cross-layer correlation, and weights the features in different spatial locations according to their intrinsic correlation, and encapsulates them into the network. Through end-to-end training, we can learn the rich texture information of art painting images, and then realize the classification of CAD art painting images.

(1) In this article, a CNN framework based on PSO is proposed, which captures the texture information of images from the visual dimension for the classification of various art painting images.

(2) An algorithm that can automatically generate distribution according to the input image is designed and developed, which improves the automation of art history knowledge extraction.

Firstly, this article introduces the significance of applying CAD and image processing technology in arts and crafts teaching. Then it summarizes the related research of scholars in this field on painting image processing, and puts forward the improvement ideas of this article; The image processing model of fine arts painting in this article is constructed from two aspects: feature extraction of fine arts painting images and learning of fine arts painting styles.

## 2 RELATED WORKS

Jiang and Yang [6] studied a painting style feature extraction method based on CNN and proposed an extraction method that combines global information and local features. In addition, this method can also be applied to other fields, such as design, photography, and digital art. By using this technology, we can extract important stylistic features from existing art works and apply them to new creations, resulting in more unique and personalized works. In summary, this method has important application value in computer-aided arts and crafts, and provides new ideas and methods for research and development in related fields. Compared with existing methods, the proposed method focuses more on extracting and utilizing global information while maintaining image content information, thereby improving the accuracy and robustness of painting style feature extraction. The study should focus on practical operations, creative exercises, communication and sharing, and teacher guidance to enhance learners' interest and skill levels. Liu and Yang [7] built dynamic and interactive web applications using ASP. NET to support students' autonomous learning and online communication. In addition, ASP. NET also provides rich development tools and libraries that can help developers quickly build efficient and stable applications. Therefore, choosing ASP. NET as the development language for the innovative teaching mode of modern art computer-aided design is a wise choice. This can fully leverage its advantages such as object-oriented, built-in controls, maintainability, and scalability. Provide strong support for cultivating artistic talents with innovative and practical abilities. Emotional image classification is an important task and has significant implications for many application fields. Traditional emotional image classification methods are mainly based on the visual features of the image, such as color, texture, shape, etc., for analysis. However, these visual features cannot fully explain the emotional information contained in the image. Therefore, in recent years, some studies have begun to explore the use of interpretable artistic features and semantic annotations to classify emotional images.

Liu et al. [8] introduced the relevant research and application of this classification method. Train classifiers through machine learning algorithms. This method not only improves classification accuracy, but also provides more intuitive explanations and visualization results. For example, by extracting and visualizing artistic features, we can clearly see the differences between different emotional categories, thereby better understanding the distribution and patterns of emotional information. Liu et al. [9] represented the parameters of the deep learning architecture as continuous variables and used the CPSO algorithm to search for them. During the search process, particles gradually find the optimal deep learning architecture by communicating with each other and tracking the optimal solution. We used a hyperspectral image dataset for experimental validation based on continuous particle swarm optimization can significantly improve classification accuracy and reduce computational costs. In addition, this method can automatically discover deep learning architectures suitable for hyperspectral image classification, avoiding the trouble of manually adjusting and optimizing network structures. Image classification and recognition have become a key task. For painting and iconography, due to the particularity and disorder of its art, this task has become more challenging. The application of convolutional neural networks (CNN), we can already solve this problem to a certain extent. Milani and Fraternali [10] explored datasets and convolutional models for painting iconography classification. In image art analysis, the cam algorithm is an effective image recognition method that can be used to recognize and extract salient features in images. Pinciroli et al. [11] conducted a comparative analysis of the application of cam algorithms in this field. The cam algorithm is an image recognition method based on convex hull calculation. It treats each pixel in the image as a point, and then uses convex hull technology to combine these points into simple geometric shapes. By calculating the convex hulls of these geometric shapes, significant regions and features in the image can be effectively identified. In image art analysis, cam algorithms can be used to recognize and extract artistic features from images. These features may include color, texture, shape, etc. By extracting and analyzing these features, one can further understand the artistic style, theme, emotions, and other aspects of the image.

Handwriting recognition is an important computer vision task that has significant implications for automated processing, identity verification, and many other application fields. CNN has made significant progress in the field of handwriting recognition. However, how to further improve recognition accuracy and optimize the parameter configuration of neural networks. Sharma et al. [12] proposed a convolutional neural network (QPSO CNN) handwriting script recognition method based on quantum particle swarm optimization. This method combines the advantages of quantum computing and swarm intelligence. Including filter size, quantity, step size, etc. to achieve higher recognition accuracy. Hyperspectral image classification mainly uses semi supervised classification methods based on spatial spectral information. This method utilizes partially labeled data and a large amount of unlabeled data for classification, improving the accuracy and generalization ability of classification. Resource investigation, urban planning, and other aspects. However, the complexity and diversity of hyperspectral images pose challenges for classification. The methods of hyperspectral image classification can be divided into traditional methods and modern methods. Traditional methods mainly include k-nearest neighbors, decision trees, Bayesian classifiers, etc. Although these methods are simple and easy to use, they are prone to overfitting and low classification accuracy for high-dimensional data. To address this issue, Wang et al. [13] proposed a hyperspectral image classification method based on particle swarm optimization coupled with multi kernel support vector machines. This method can utilize the global search ability of particle swarm optimization and the parallel computing ability of multi kernel support vector machines to improve the classification accuracy and efficiency of hyperspectral images.

Art inheritance is an important component of cultural inheritance. In architectural design, the generation of traditional patterns and forms is an important manifestation of artistic inheritance. Digital sculpture, as an emerging technology, provides new possibilities for the generation of traditional mode forms. Xu et al. [14] explored educational courses on the generation of traditional patterns and forms in architectural design based on digital sculpture, aiming to help students master digital sculpture technology and apply it to architectural design. Currently, image classification technology based on deep learning has been widely applied in various fields, including art education. CNN can also further improve performance by adding dimensionality reduction layers similar to global average pooling. This dimensionality reduction layer can help the model better capture global information in the image, thereby improving the accuracy of classification. Deep learning technology has achieved significant results in the field of image classification. As an important platform for cultivating artistic talents, the art education system has a high demand for image classification technology. Yi [15] aims to research image classification methods for systems based on deep learning of art education. When using art reviews to classify paintings, it is important to be careful not to confuse classification methods with evaluation methods. Classification is only to help us better understand and appreciate painting works, not to evaluate the quality of the works. For each painting, we should appreciate and understand its uniqueness with an open mind. Zhao et al. [16] explored datasets and convolutional models for painting iconography classification. We introduced several large public datasets and elaborated on how to use CNN models. The CNN model with preprocessing and data augmentation can achieve high classification accuracy. In the future, we will continue to explore more effective data augmentation techniques and complex model structures to further improve the classification and generalization capabilities of the model.

Image processing technology can also be used in arts and crafts teaching. For example, operations such as cropping, resizing, rotating, and mirroring can all be used to process images. These technologies can help students change the shape and structure of images, thereby creating more unique and interesting design works. At the same time, filters and special effects can also be used to change the color and texture of images, enhancing their three-dimensional and artistic effects. Finally, CAD and image processing techniques can also be applied in practice. For example, in practical applications such as product prototyping, advertising, and trademark design, these techniques can help students better master design skills and express their creativity. In summary, CAD and art painting image processing technology have extensive applications in arts and crafts teaching. They can help students better master design skills and better express their creativity.

Identifying art painting images is different from the fine-grained classification task of general images, and its classification depends not only on the salient objects in the images, so it is not accurate to distinguish art painting images by conventional image classification methods. In this article, the application of two technologies in arts and crafts teaching is discussed, and a feature extraction method of art painting images based on PSO-CNN is proposed.

## 3 METHODOLOGY

### 3.1 Feature Extraction of Art Painting Images

In PSO, each solution is called a "particle", and each particle has a position and velocity. By iteratively updating the position and velocity of particles, the optimal solution is approached step by step. CNN is a deep learning (DL) algorithm, which is suitable for image processing and classification tasks. CNN extracts image features through multi-layer convolution layer, pool layer and full connection layer. In the classification of art painting images, CNN can effectively capture the texture, shape, strokes and other features of images. PSO-CNN combines the advantages of PSO and CNN to extract the features of art painting images. Firstly, the weight and bias of CNN are taken as the solution of particle position, and then PSO algorithm is used to optimize these parameters. In each iteration, PSO updates the position and velocity of particles according to the fitness function (classification accuracy), and gradually optimizes the parameters of CNN. In this way, PSO-CNN can automatically adjust the parameters of CNN to adapt to the task of feature extraction of art painting images. The feature extraction process of art painting image based on CNN is shown in Figure 1.

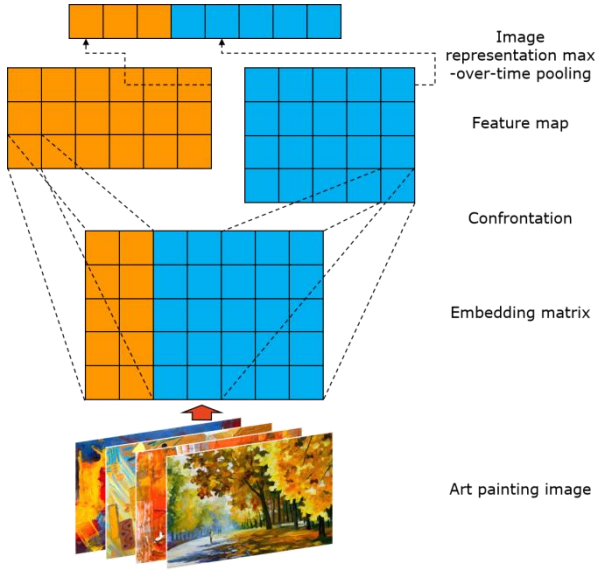


**Figure 1**: Feature extraction of art painting images.

The PSO-CNN method mainly includes three steps: firstly, the weight of CNN is optimized by PSO algorithm to achieve the best feature extraction effect; Secondly, automatic feature extraction of art painting images is carried out through CNN to obtain the internal features of the images; Finally, the extracted features are classified by classifier to realize effective recognition of art painting images.

$$Y_i^k = f\left(X_i^k\right) \tag{1}$$

$$X_i^k = \sum_{j=1}^{n+1} W_{ij} Y_j^{k-1} \tag{2}$$

$$f\left(x_i^k\right) = \frac{1}{1+\exp\left(-X_i^k\right)} \tag{3}$$

$$e = \frac{1}{2}\sum_i \left(Y_i^m - Y_i\right)^2 \tag{4}$$

PSO-CNN takes CNN's weight and bias as the solution of particle position, and optimizes CNN's parameters through PSO algorithm. This enables CNN parameters to be automatically adjusted according to the characteristics of classification tasks, thus improving the classification performance. PSO-CNN can automatically adjust CNN parameters according to different classification tasks, so that the model can better adapt to different data sets and tasks. This adaptive ability makes PSO-CNN have better performance in dealing with the task of fine art painting image classification.

When the individual optimal position of particle $i$ is not obviously improved in successive $k$ iterations, the neighborhood search operator is executed to improve the development ability of the algorithm in the search range, so as to jump out of the local optimal. The specific conditions for executing neighborhood operators are:

$$fp_i^t - fp_i^{t-k} = 0 \tag{5}$$

$fp_i^t$ represents the fitness value of $p_i^t$, and $p_i^t$ represents the optimal individual position of particle $i$ at the $t$-th iteration.

Traditionally, the population diversity should be kept at a relatively high level, but the ideal population diversity curve should decline slowly and have large vibration frequency and amplitude, especially in the early stage of algorithm operation. This algorithm can search the whole area as comprehensively as possible before premature convergence, and can find the balance point between global search and local search as soon as possible. Therefore, this article constructs the following linear function as the reference input of diversity.

$$D_i(t) = a\left(1 - \frac{t}{b \times Maxiter}\right) \tag{6}$$

$Maxiter$ represents the maximum quantity of iterations allowed, and $a, b \in (0,1)$ represents the control coefficient of the reference input. This reference input can be linearly reduced from the initial value $a$ to 0 in a limited time, and the effect of evolution will make the actual diversity curve find a certain frequency oscillation.

In order to improve the convergence speed of PSO, time-varying function is used to adjust the inertia weight in the position updating formula.

$$\omega = \omega_{\max} - \frac{\omega_{\max} - \omega_{\min}}{T_{\max}} t \tag{7}$$

### 3.2 Learning and Classification of Art Painting Style

The study of art painting style aims to understand and master the painting styles of different artists. In this process, the color, texture, shape and strokes are extracted from the painting image by using the feature extraction method introduced in Section 3.1. Through the analysis of these characteristics, researchers can deeply understand the painting styles of different artists and extract the corresponding style characteristics. The learning and classification process of art

painting style based on PSO-CNN is as follows: data preprocessing: preprocessing of art painting, including image clipping, resizing, color space conversion and so on. Feature extraction: CNN is used to extract the features of the pretreated art painting. Style classification: input the extracted features into the classifier optimized by PSO for classification. Evaluation of performance: Evaluate the performance of the classifier by cross-validation. See Figure 2 for the learning principle of art painting style.

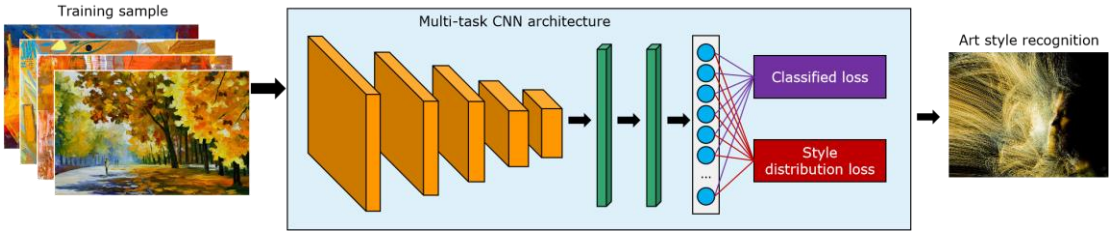


**Figure 2**: Learning principle of art painting style.

In order to make the advantageous genes of the dominant individuals in the population pass on to the next generation, in the process of hybridization and crossover of the next generation, the best genes of the parent individuals, that is, quantum particle individuals with high fitness values, should be selected to enter the next generation, and the probability of being selected is as follows:

$$F_i = \frac{f_i}{n_i - \ln t(M \times \eta)} \tag{8}$$

$f_i$ is the individual fitness value, $M$ is the sum of population fitness values, and $\eta$ is the expected selection rate.

During the update operation, the particles to be updated are crossed with the historical optimum of the particles to be updated, and then crossed with the global optimum of the particle swarm, resulting in a new position, and the new particles are locally exchanged, specifically described as the following formula:

$$X_i = c_2 \otimes g(c_1 \otimes g(X_i, Pbest_i), gbest) \tag{9}$$

$$X_i = \omega \times f_{a,b}(X_i) \tag{10}$$

Among them, $c_1, c_2, \omega \in [0,1], (\omega \geq 0.6)$, $g(X_i, Pbest_i)$ operations mean crossing with probability $c_1$ according to the size relationship of fitness values in the same column.

In the process of image transmission and processing, the pixel value affected by noise can be expressed as:

$$F(x,y) = f(x,y) \cdot (1 + n(x,y)) + N(x,y) \tag{11}$$

Where: $n(x,y)$ represents multiplicative noise; $N(x,y)$ means additive noise.

Browse pixels from the center to the edge and calculate the distance between them:

$$C_j = C_i - \frac{f(C_i)}{f'(C_i)} \tag{12}$$

Where $C_i$ represents the central pixel and $C_j$ neighborhood pixels.

Using DL technology, a large quantity of noisy images and corresponding noiseless images are trained to learn the denoising law, which can remove noise while preserving the details and features of the images.

## 4 RESULT ANALYSIS AND DISCUSSION

This article not only studies the application of CAD and art painting image processing technology in arts and crafts teaching, but also puts forward a method of extracting the features of art painting images based on PSO-CNN. By visualizing the feature extraction results of PSO-CNN algorithm, we can understand how the algorithm extracts key features from art paintings. Compare the feature extraction results of traditional CNN algorithm and analyze the differences between them, so as to better understand the advantages of PSO-CNN algorithm. Different types of fine arts paintings, such as sketch, watercolor and oil painting, were selected for testing. Observe the performance of PSO-CNN algorithm on different types of images, and analyze the adaptability of this algorithm to different painting styles. In order to test the robustness of PSO-CNN algorithm, the features of images with different clarity and quality are extracted, and the performance of the algorithm under different image conditions is observed. Figure 3 shows the precision test results of different feature extraction algorithms.

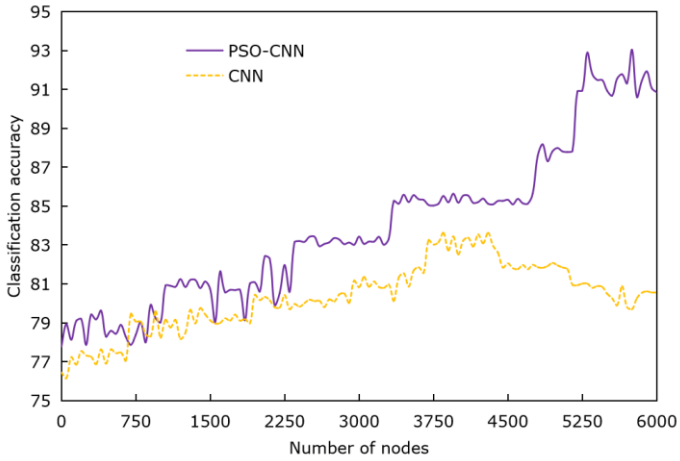


**Figure 3**: Precision test of different feature extraction algorithms.

The feature extraction algorithm of CAD painting image proposed in this article can ensure the clarity and three-dimensional sense of the image to a certain extent on the premise of ensuring the clarity of the image. Compared with the traditional CNN algorithm, its precision is improved by more than 15%.

In the experiment, art paintings with different resolutions and sizes were selected for testing, and the time of feature extraction and dimension reduction calculation of different algorithms was recorded. The advantages of PSO-CNN algorithm in feature extraction and dimension reduction can be understood more deeply by comparing and analyzing the calculation time of different algorithms. The calculation time statistics of image feature dimensionality reduction by different algorithms are shown in Table 1.

| *Painting type* | *Training sample* | | *Test sample* | |
|---|---|---|---|---|
| | *CNN* | *PSO-CNN* | *CNN* | *PSO-CNN* |
| Sketching | 7.88 | 6.15 | 8.45 | 6.19 |
| Watercolor | 7.49 | 6.07 | 6.88 | 5.01 |

| painting<br>oil painting | 8.88 | 7.26 | 6.97 | 4.79 |
|---|---|---|---|---|

**Table 1**: Dimension reduction time of painting image classification model.

The results show that PSO-CNN algorithm has some advantages over traditional CNN algorithm in computing time. This is mainly due to the performance improvement of PSO algorithm in CNN optimization, which makes PSO-CNN algorithm find the optimal solution faster. PSO-CNN algorithm has good adaptability for fine arts paintings with different resolutions and sizes. This enables the algorithm to deal with various images of different types and qualities in practical applications.

Time factor has an important influence on the classification accuracy of painting images. Time factor can be regarded as the time control factor of the algorithm when searching for the optimal solution, and its value directly affects the performance and search efficiency of the algorithm. When the time factor is too small, the algorithm may end the search before fully searching for the optimal solution, resulting in low accuracy; When the time factor is too large, the algorithm may spend too much time searching for non-optimal areas, which will also affect the accuracy. Therefore, choosing the appropriate time factor is one of the key factors to improve the performance and accuracy of the algorithm. Figure 4 shows the change of classification accuracy of painting images when the time factor is between 0 and 1.

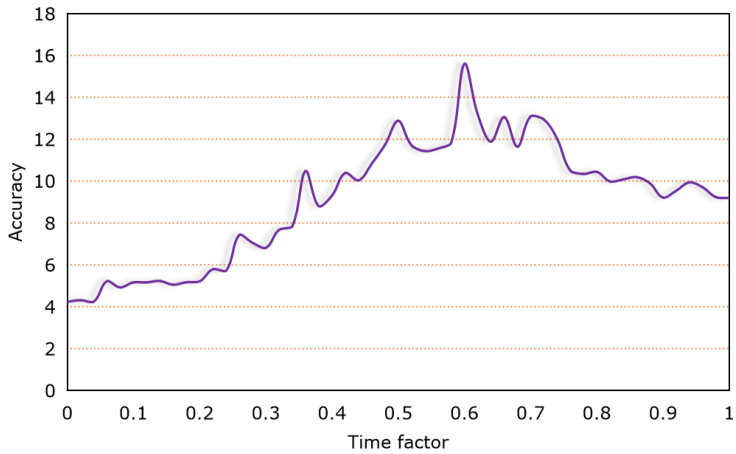


**Figure 4**: Relationship between time factor and accuracy.

The change of classification accuracy based on time factor shows a dynamic trend of first increasing and then decreasing. When the time factor is 0.6, the accuracy reaches the peak, so 0.6 is chosen as the time factor. According to the results in Figure 5, the classification accuracy of PSO-CNN can be analyzed in detail.

The classification accuracy of each type of art painting works is analyzed in detail: sketch is a kind of painting form that expresses the image with lines and shadows. In the experiment, PSO-CNN algorithm achieves 96.1% accuracy for the classification accuracy of sketch works. Watercolor painting is a kind of painting form with water as the medium, which expresses the picture through the transparency of pigment and the fluidity of water. In the experiment, PSO-CNN algorithm achieves 91.8% accuracy for the classification accuracy of watercolor works. Oil painting is a kind of painting form with oil as the medium, which expresses the picture through the thick coating of pigments and the layering of colors. In the experiment, PSO-CNN algorithm achieves 93.8% accuracy for the classification accuracy of oil paintings.

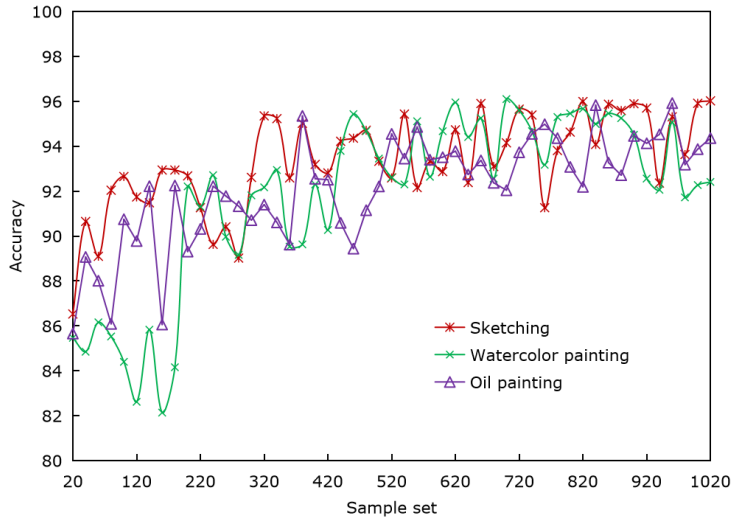


**Figure 5**: Classification accuracy of painting images by PSO-CNN.

According to the test results in Figure 5, PSO-CNN algorithm shows high accuracy in different types of art painting classification tasks. For sketches, watercolors and oil paintings, the classification accuracy of PSO-CNN algorithm is over 90%, which shows that the algorithm has a good application prospect in the field of arts and crafts teaching. Moreover, the experimental results also provide a useful reference for us to further optimize the algorithm and improve the application scenario.

The curve of the optimal solution of PSO-CNN algorithm in the process of painting image classification shows a steady and rapid convergence trend. This result shows that the algorithm has good effectiveness, search efficiency and stability in the task of art painting image classification. This result provides a useful reference for further optimizing the algorithm and improving the application scenario. Figure 6 is the variation curve of PSO-CNN optimal solution.

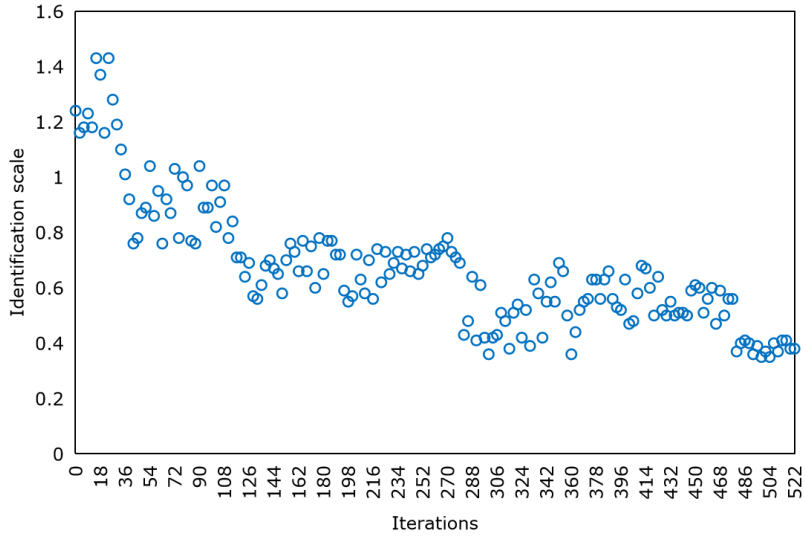


**Figure 6**: Variation curve of optimal solution.

With the expansion of the training dataset, the model can learn more image features and patterns, thereby improving the accuracy and generalization ability of classification. This helps to accelerate the process of model convergence to the optimal solution. The curve converges to the optimal solution smoothly and quickly, which shows the effectiveness of PSO-CNN algorithm. The algorithm uses PSO algorithm to optimize the weight and bias of CNN, and can find the optimal solution in a short quantity of iterations, which shows that the algorithm has good performance in the task of fine art painting image classification.

Figure 7 shows the error change of test set with the increase of training rounds. As can be seen from the figure, with the training, the error of the test set is decreasing, which shows that the performance of CNN classifier is improving. The average error rate of CNN classifier on the test set is 1.44%, as shown in Figure 7.

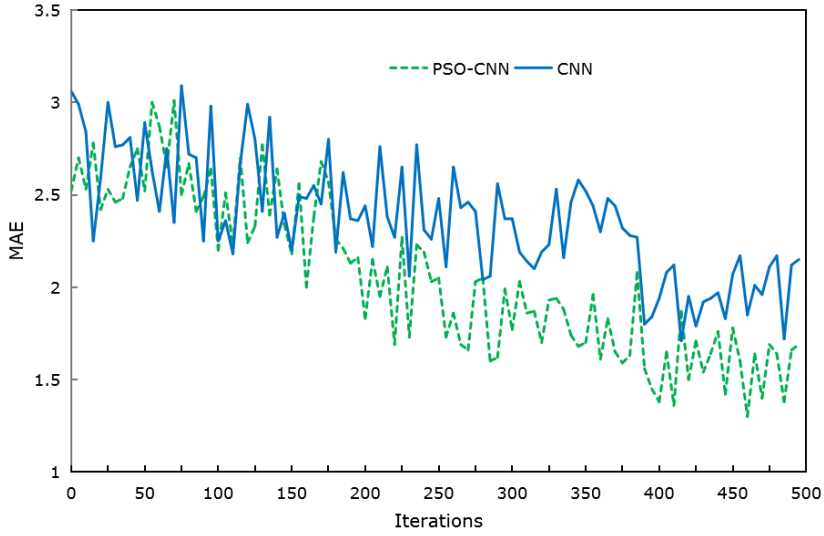


**Figure 7**: Error changes in training process.

At the initial stage of training, although the error of training set is decreasing, the error of test set is relatively high. This may be because the CNN classifier has not fully adapted to the data set when it first started training, and it is still in the learning stage. At this stage, the classifier may be trying to understand the features, patterns and relationships in the data. As the training goes on, we can see that the error of the test set begins to decrease obviously. This shows that the classifier has gradually adapted to the data set and started to identify important features for classification. At this stage, the performance of the classifier has been significantly improved.

This method can not only improve the teaching efficiency, but also help learners to better master modern design skills, and provide new ideas and directions for the growth of arts and crafts teaching. For the problem of improper use of color in painting learning, we can use image classification technology to classify and analyze the works with proper use of color and the works with improper use, so as to help learners better master the skills of using color.

## 5 CONCLUSIONS

The integration of CAD and arts and crafts teaching is an urgent topic at this stage, which has strong practical significance. The image processing technology of fine arts painting can provide more abundant teaching resources and means for arts and crafts teaching. The use of image

classification technology in arts and crafts teaching can help learners better understand their learning situation and improve their learning effect, and can also help educators better understand learners' learning problems and improve teaching quality. Compared with traditional CAD and art painting image processing technology, PSO-CNN method has higher accuracy and efficiency. Moreover, this method can also provide learners with more intelligent and automatic learning experience, thus better promoting the effect of arts and crafts teaching.

The computation and storage capacity of DL are relatively large, which will limit the transplantation of DL to mobile devices or embedded development platforms. Therefore, how to compress the parameters of deep network, propose a new acceleration algorithm, and extend the related applications based on DL to more platforms needs further study. In addition, we can further explore how to apply PSO-CNN method to other arts and crafts teaching fields, such as fashion design and interior design, so as to provide more intelligent and automated teaching tools and means.

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