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Application of computer data model in the characteristics and evolution of ceramic decorative painting

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Abstract: **-** With the rapid development of computer technology, computer information technology has made intelligent transformation to all industries. It is particularly important to optimize the computerization of ceramic painting. This paper analyzes the development of ceramic decorative painting and the basic principle of computer data model, determines the method of combining ceramic decorative painting with computer data model, and establishes a computer data model for feature extraction of ceramic decorative painting. And 1015 images of self-made ceramic decorative paintings are applied to carry out simulation analysis. The results show that compared with the traditional classification algorithm based on non deep learning and the partial classification algorithm based on deep learning, the average F1 value of the hybrid neural network model is 96.4%, which is 1.5% higher than the best traditional model. This shows that the designed computer data model for feature extraction of ceramic decorative painting has a good effect on the classification and feature recognition of ceramic painting. This has laid a certain foundation for the computerized optimization of ceramic decorative painting and provided a good support for the healthy development of ceramic decorative painting in the information age.

Keywords: Ceramic decorative painting; Computer data model; Feature extraction and analysis; Convolutional neural network.

I. INTRODUCTION

Ceramic decorative painting has unique characteristics in artistic expression, technology and style. It is developed in its own system and laws. It continues to learn and connects with other arts and crafts. It has become a modern decorative ceramic material. It can be seen that there is not only the influence of bronzes and lacquered goods, but also the decorative significance of weaving, embroidery and dyeing, as well as the style of Chinese painting and wood painting. It can be said that ceramic decoration has been widely absorbed and accumulated. Therefore, ceramic decoration has different forms of expression and rich artistic connotation. As a unique decorative art and painting in the world, it has written a unique chapter in the history of art development. Ceramic art is a formal feature of modeling and decoration, which is also based on materials and technology. Ceramic decoration is subordinate to modeling, and the combination of the two forms a complete artistic effect; Ceramic decoration has a relatively independent form of expression that develops planar patterns and images into three-dimensional shapes. With the development of computer technology and information technology, it is especially important to combine ceramic decorative painting with the current advanced computer data model technology to make ceramic decorative painting glow with new vitality in the new era.

A. historical development and current situation of ceramic decorative painting

"Painting" was in ancient times a form of painting using traditional materials such as pen, ink, paper and ink. Since the introduction of Western painting to China, there have been differences between Chinese traditional painting and Western painting. Among them, it is a ceramic decoration based on the development history of Chinese painting. It follows the development trend of Chinese painting and follows the traditional painting style, which is both refined and popular. Therefore, it has a broad social impact in the field of ceramic decorative painting. The influence of Chinese painting on ceramic decoration is far-reaching. Mr. Deng Bai once wrote, "Ceramic color painting has absorbed painting techniques and achieved an amazing development. Whether blue and white porcelain, color porcelain or other color porcelain, the decoration of the painting style has taken on a new look. Jingdezhen is an area with a long history of ceramic culture [1]. Every ceramist has known Chinese painting since childhood and can even use a brush. It is this culture that combines the traditional painting form with more New Year pictures, door gods and folk art, and applies them to ceramic decoration. The process properties, feasibility and market conditions of ceramic products determine the essential properties of ceramic coatings, unlike paper coatings. Ceramic process factors limit ceramic coatings depending on the baking atmosphere and process. Ceramic painting is a pure form of painting. It looks like a complete picture. It differs from the decorative patterns on utensils. It shows a decorative form based on painting. Decorative painting is

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closely related to ceramic painting. It belongs to the large-area ceramic painting system and has decorative properties. "Decorative painting" refers to the use of decorative treatment in the painting language, such as the five colors in ceramic decoration. Under the influence of wood carving illustrations and New Year pictures, the patterns were applied to porcelain, giving simple shaped containers a certain decorative charm [2].

a) characteristics of ceramic painting in song and Yuan Dynasties

The Song Dynasty Cizhou Oven Black Flower "Doll Painting" is a black underglaze painting of Cizhou Oven. Especially porcelain cushion paintings are based mainly on the life scenes people loved back then and are full of interest in life and sense of humor. It not only preserves the historical materials of folk painting in the Song Dynasty, but also preserves folk painting materials in the Song Dynasty. The themes of ceramic cushion paintings include circus, baby games, etc., especially children's games, such as fishing, birds, birds, ducks, quails, etc[3].

b) characteristics of ceramic painting in the Ming and Qing Dynasties

Beans appeared in Dai Chenghua. With the appearance of Kangxi ancient paintings in the Ming and Qing dynasties, the characters in Kangxi ancient paintings are mainly composed of secular characters, mythological characters, historical characters, opera characters, novels, young girls, children's dramas and senior officials. The secular, mythical, historical and operatic characters had close ties to the then highly developed printed illustrations. The appearance of color paintings in the Qing Dynasty enriched the types of paintings. There are many decorative ceramic paintings. Kangxi's colourful figure story painting shows a loving mother who took her son to play in the country on a sunny morning. In the painting, rocks, grass and trees are brittle. The child chased a dancing dragonfly with a fan. The mother took care of the child and told him not to fall. At the end of the Qing Dynasty, we had to talk about "red shops". In the Ming Dynasty (1368-1644), it was a family-style workshop based on enamel painting. In the Ming and Qing dynasties, the "Red Chamber" arose with the demand for official oven porcelain. They make glazed porcelain for official ovens and are not allowed to copy and make "personal items". In a sense, the activities of red shops are limited. After the outbreak of the 1911 revolution, with the end of feudal rule and the closure of imperial furnaces, the Hongdian business area became active in history. At that time, the painters of the Guanyao factory also opened a "red shop". At that time, there were two types of "old red store" and "official red store". Guhongdian mainly imitates the old porcelain of the official Ming and Qing ovens. Well, another kind of "new red shop" refers to the studio of literary ceramic artists [4].

c) Main characteristics of ceramic painting in the Republic of China

In the early period of the Republic of China, various colored glazes were burned back to ashes and new colored glaze materials appeared. They're colored and laminated. They have a significant influence on the position of light red on porcelain. In addition, their technology is superior to dark and light red instead of dark and light red.Over time, the material falls off slightly and loses shine. Soon this glaze called "new plaster" replaced the bright red. Zhushan Bayou is an outstanding representative and a group of like-minded folk artists here.

The appearance of light red opened up a new perspective for Chinese ceramic painting. Ceramic painting developed under the influence of Chinese painting. Although this path is difficult to follow, it is still evolving. First of all, Zhu Shan's eight friends introduced Western painting and literary painting to porcelain painting, and her painting methods integrated antiquity and modernity. Later, in Ceramic Creation, the appearance of new colors and the participation of artists in other forms of painting brought a new situation to ceramic painting [5].

d) Characteristics of contemporary ceramic decoration

Ceramic painting art has developed to this day and shows a variety of colors. It can be said that scientific and technological progress has created the conditions for innovation in applied art. As new technologies and new materials emerge, they will be actively discovered and investigated, but they will also have negative effects. If people excessively pursue technology to cover up the defects of their own artistic level, they will think that technology is a striking art that satisfies the curiosity of some people, performs an "express train", blindly pursues technical perversions, and moves towards formalism. More importantly, driven by market interests, they largely imitate the creative achievements of others, but only shape their own image. Compared to the past, there are not only artists, students and teachers, but also many other artists on the market. Ceramic painting Language and form are relatively rich His art theory is constantly updated and changed. The accumulation, integration and collision of ceramic art in the last thousand years are new opportunities and challenges for contemporary ceramic art from Western European culture.

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B. Basic principle and classification of computer data model

In the information society, database technology is the core of the management information system, office automation system and decision support system. Data model is the storage and operation mode of data in the database. This is the basis of the database system. There are many relationships between objective things in the real world. Data model is an abstract process of filtering, induction, synthesis and naming. It generates a conceptual model to express the description of the real world, and then converts it into a real one, easy to understand and easy to process from the computer. The data model is used to represent the objects in the real world, that is, the chaotic information in the real world. According to different levels of model application, the data model can be divided into conceptual data model, logical data model and physical data model. Among conceptual data models, E.R. and object-oriented models are most commonly used to describe the conceptual structure of the world. It allows the database designer to design the database at the beginning of the design and focus on the analysis of the data and its links; The logical data model reflects the views of system analyses and designers on data storage and further decomposes and refines the conceptual data model. Among them, hierarchical model, lattice model, relational model and big data model are the most common. The physical data model describes the organizational structure of the data on the storage medium [7]. Based on the logical data model and considering various specific technical factors, it designs the database architecture and realizes the storage of data in the database. See Figure 1 below for the structure diagram of data warehouse.

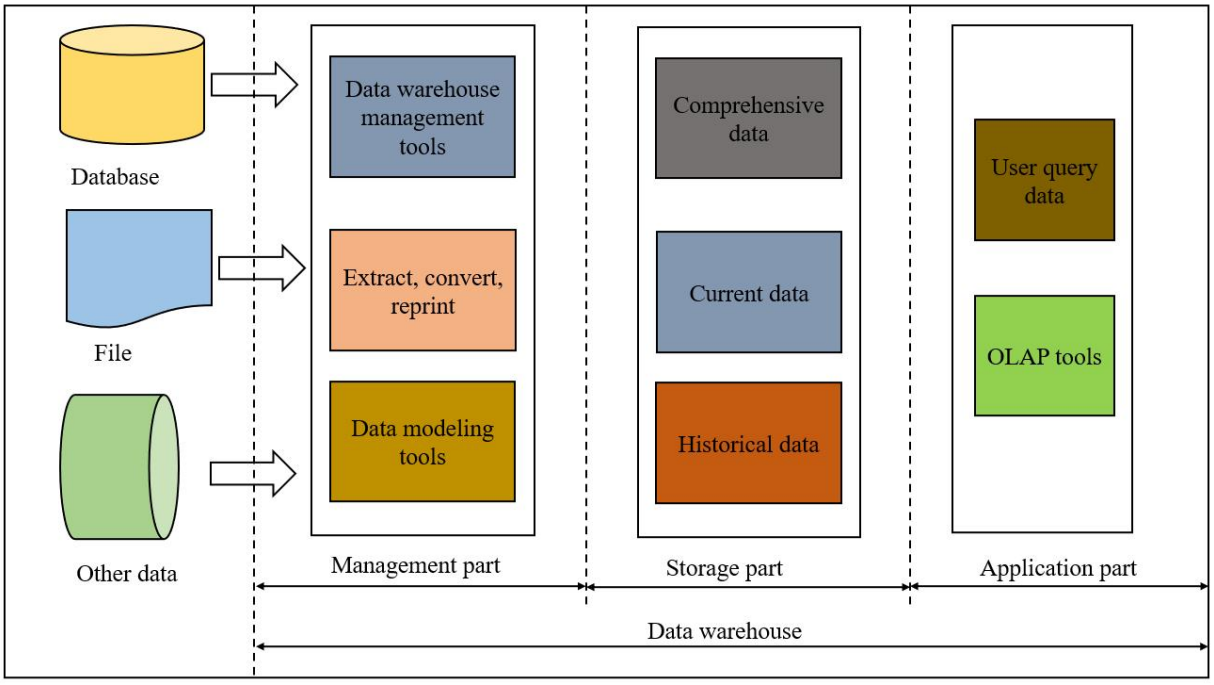

Figure 1: See figure x below for the structure diagram of data warehouse

a) structured computer data model

Structured model is the first proposed data model and one of the most basic data models. Structured model mainly includes hierarchical model, lattice model, relational model, and object-oriented model.

b) Computer data semi-structured model

Although the structured model can well describe the relationship between entities in the real world, it lacks effective support for semi-structured data such as text files, hyperlinks, HTML documents, which differs from the structured model. The characteristics of the semi-structured model include mainly implicit model information, irregular structure and the absence of strict type restrictions. Semi-structured models include XML model, UI) f model, JSON model, graphics model, and hypermodel [8].

c) Computer data analysis model

The data analysis model can easily and reliably process unlimited data flow. Like batch processing of big data, the data analysis model can process data in real time. The data analysis model is easy to use and can use any programming language. The data analysis model implements the current data model and the data flows continuously in the network, which consists of several transformation units. The abstraction of a data stream is called a stream. A stream is an infinite sequence of tuples. A tuple resembles a data structure that can represent standard data types such as int, float, and byte arrays, as well as custom types that require additional serialization code. Each data flow is identified by a unique ID that can be used to create a data source for each component in the topology. The basic principle of data analysis model is shown in Figure 2.

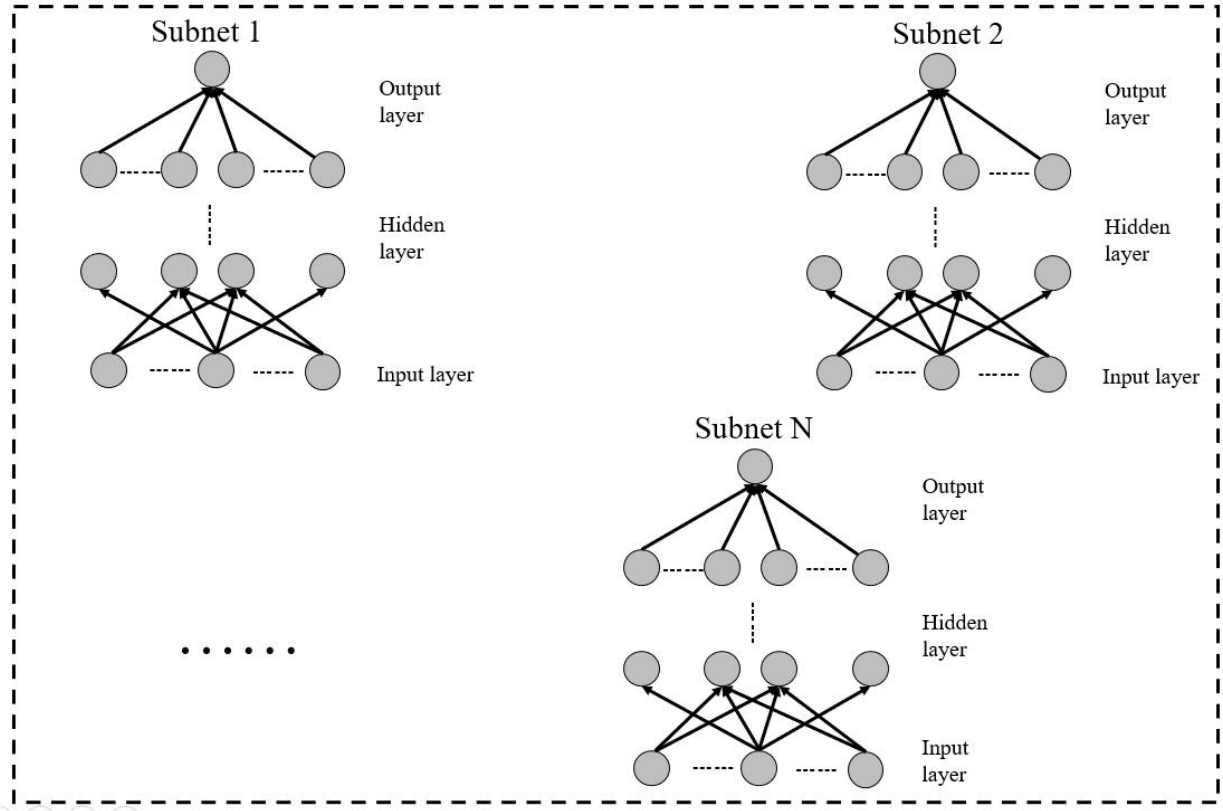

Figure 2: basic principle of data analysis model

d) Internet model of big data

With the rapid development of Internet, Internet of things, social networks and other technologies, the traditional data model has been unable to cope with the explosive growth of data volume. In order to solve the storage bottleneck and management complexity caused by these massive data, the big data model represented by NoSQL and newsql database systems has gradually become a new research hotspot.

In the area of the database, the data model is used to represent the objects in the real world, i.e. the disordered information in the real world is standardized and visually expressed. After almost half a century of development, the data model has created a solid theoretical foundation and a wide range of applications [9].

II. NECESSITY OF APPLYING COMPUTER TECHNOLOGY TO CERAMIC ART CREATION

A. Improve the manufacturing accuracy of ceramic products

Since the third scientific and technological revolution, computer technology has reached thousands of households in different ways. The information age is developing rapidly. It has made great contributions to improving the quality of life and productivity of today's people. This computer was designed and sent to the

machine to release people's hands. At the same time, the accuracy and efficiency of computer work are beyond human reach. In nature, it is difficult to have two identical sheets on the same tree, but 3D printing can be easily completed. Even skilled workers can only make almost the same craft, but computers can do it exactly the same, and there is no difference at the micro level, because the same code generates commands for them. In ceramic design, the color depth and the position of the pattern can be well captured. In addition, computers for production, repetition and testing can run without wasting resources, which not only improves efficiency, but also promotes environmental protection.

B. Improving productivity

The application of computer technology in production can not only plan and design in the early stage of production, but also significantly improve production efficiency. Computer programming has high efficiency, high accuracy and strong systematics. Programming language can improve the production process and capture the time process more accurately. The gradual improvement of production efficiency is not only an effective instrument for promoting industrial development, but can also bring more benefits to industry and save sufficient human and material resources. One of the biggest shortcomings of the ceramic industry in the past is the high waste rate. The introduction of computer technology has solved this problem. During the manufacturing process of lamps and lanterns, cracks and defects can easily occur due to weather and fire. The application of digital computer technology has significantly avoided the damage and waste caused by human factors, improved production efficiency, and promoted the development of ceramic science and technology [10].

C. Improve the aesthetic level of ceramics

From an aesthetic point of view, the combination of computer technology and ceramic design also promotes modern aesthetics. The two complement each other. Modern aesthetics is the combination of the latest avant-garde aesthetic ideas of the modern public. The transformation of modern aesthetics can be completed quickly through the use of computer technology [11-14]. If the ceramic industry does not solidify and remains in the original traditional aesthetic design, it will be replaced by substitutes and disappear in the long history. Therefore, whether it is art ceramics or practical ceramics, their shape design must be closely linked to computer technology and change with the changes of modern aesthetics. With the continuous development of aesthetics, aesthetics can also be divided into classical aesthetics, medium aesthetics and modern aesthetics. It is a sign of the maturity of the ceramics industry to keep pace with the times and constantly innovate and change. With the development of computer technology, ceramic production is becoming increasingly diversified. The inspiration of networking materials for designers cannot be ignored. Computer library can provide many design ideas for designers.

D. Improvement of the ceramic production process

The combination of computer and technology plays an important role in promoting the scientific development of the ceramics industry. With the development of computer graphics and computer programming, ceramic production has entered a new era. It improves production efficiency, accelerates the iteration cycle of products and makes ceramics no longer a traditional craft industry, but a modern industry that can be produced on a large scale. In the process of ceramic design, the support of computer technology eliminates the tedious manual physical operation, improves the production environment, avoids the risk of production downtime and production waste, and ensures the development of the ceramic industry [15].

E. promote the systematization of ceramic decorative painting production

The application of computer technology promotes the systematization of ceramic production. The ultimate purpose of decorative ceramic coating design is to put it into production, reduce production costs and improve industrial efficiency. The process from design to production is the manufacturing process of virtual reality. Ceramic decorative painting also belongs to the category of ceramic design art and is the last important link of ceramic design art. Computers and technology organize the production process in the production process to ensure the stability of production. At the same time, a reasonable process design is also helpful to reduce working time and costs. If the structure scheme is reasonable, all aspects of the production process can be tested on the computer. In addition, it can also monitor the production process in real time and process and replay production problems in time. There is no doubt that this is a great advance in the production of ceramic decoration, which greatly promotes the industrialization of ceramic decoration [16-18].

III. ANALYSIS OF THE COMBINATION OF COMPUTER DATA MODEL AND CERAMIC DECORATIVE PAINTING

Ceramic decorative painting shows its unique artistic style and cultural heritage in the historical development. Ceramic painting is one of the treasures of Chinese traditional culture. Studying its classification is helpful to the inheritance and development of traditional culture. Under the background of effective management of Digital Art Museum, the research and identification technology of ceramic painting has become a hot research topic. Therefore, a ceramic painting classification algorithm based on global CNN[19-22] and local LSTM is proposed to realize the classification of ceramic paintings. The algorithm captures the general style features and local stroke features of ceramic paintings at the same time, and improves the classification accuracy. A CNN network of computer data model is designed to keep the general style of ceramic painting, and then the ceramic is divided into blocks. The LSTM network is designed to handle these areas to maintain the correlation and operational characteristics between the areas. Finally, we design a feature fusion strategy, that is, adding an adaptive weighted fusion layer in the algorithm, and adaptively weighting the above two features through learning methods. This is the final expression of the performance of the ceramic coating sent to the softmax classification layer for classification. In order to verify the effectiveness of the algorithm, a comparative experiment with ceramic decorative paint group was carried out. Experimental results show that this model can achieve 96% classification accuracy, which is better than other algorithms. Ceramic painting has a unique artistic style. It has a long history and cultural tradition. It shows ancient and modern ceramic artists and painting skills. It enjoys a high reputation in the art circles at home and abroad. Local ceramic painting enthusiasts emerge in an endless stream and have received extensive attention. In this context, the digital management of ceramic painting has become an irresistible trend. Therefore, the classification of digital ceramic decorative paintings is of great significance.

Currently, there are two big data calculation models for the classification of ceramic paintings: classification method based on flat features and classification method based on deep learning. Literature research shows that the learning effect of the flat learning method is generally lower than that of the deep learning method due to the strong network learning ability. In addition, features are the basis of image recognition. How to improve the application of features is the premise of improving classification accuracy. On this basis, an algorithm for classifying ceramic decoration images based on CNN and LSTM is proposed. The neural folding network is used to extract the global characteristics of decorative ceramic paintings, capture the overall style of decorative ceramic paintings, and long-term and short-term memory networks are used to extract the local characteristics of images to improve the robustness of the algorithm. Then the adaptively weighted fusion of the two characteristics is sent to the classifier, which greatly improves the classification effect.

IV. FEATURE EXTRACTION MODEL OF CERAMIC DECORATIVE PAINTING BASED ON MIXED DIGITAL MODEL

A. Hybrid ceramic decorative painting extraction network model

Considering that conventional methods do not take into account the correlation between different sections of ceramic decorative paintings and ignore the effects of certain positions on classification, this chapter proposes a parallel network model based on global CNN and local LSTM, to improve the classification accuracy of ceramic decorative paintings. The model receives all ceramic and decorative images as input network via CNN to capture the style of ceramic decorative paintings. Through LSTM network, we can obtain information about the importance of ceramic decorative patterns in different regions. The feature information obtained by applying the two self-construction methods can effectively fill the void of the entire image as model input. The computer model structure proposed in this paper is shown in Figure 3.

Parallel application of cnn-lstm mixed model in ceramic decorative painting in addition, the content of ceramic decorative painting can be identified by parallel examination of the general and local characteristics of the image. The model consists of the following three parts:

(1) Global cable television network. Ceramic drawing display is the input of the global CNN network, and the network model is established in the learning process.We pay particular attention to the general information about ceramic and decorative painting styles.

(2) Local LSTM network. It is obtained by dismantling the expression of ceramic decorative painting pictures in different regions based on the original pixels, local positions and specific positions were segmented into the entire ceramic decoration image using LSTM.The patterns of decorative ceramic paintings are used to extract local stroke features

(3) Adaptive weighted integration. These two branches each form important features of ceramic decorative painting pictures, and adaptive weighting and integration are used to enrich the characteristic information.

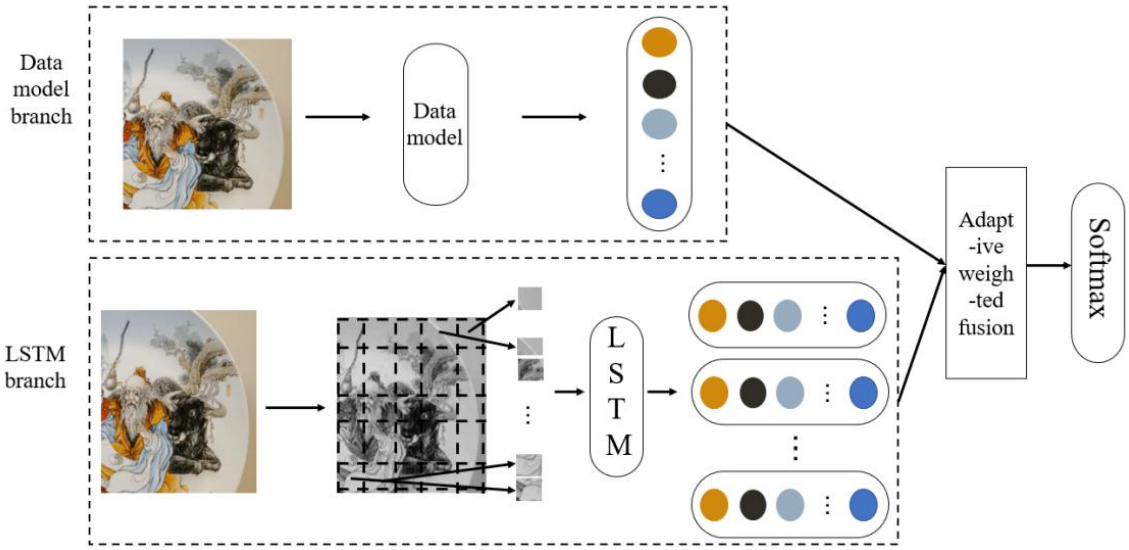

Figure 3: Basic model diagram of computer data

B. Basic principle of extraction model of mixed ceramic decorative painting

The neural folding network is used to describe the overall style of decorative ceramic patterns CNN is a basic neural network with folding structure. The more layers, the greater the extraction property. Computer data model network is a classical CNN network, with a structure as shown in Figure 4.

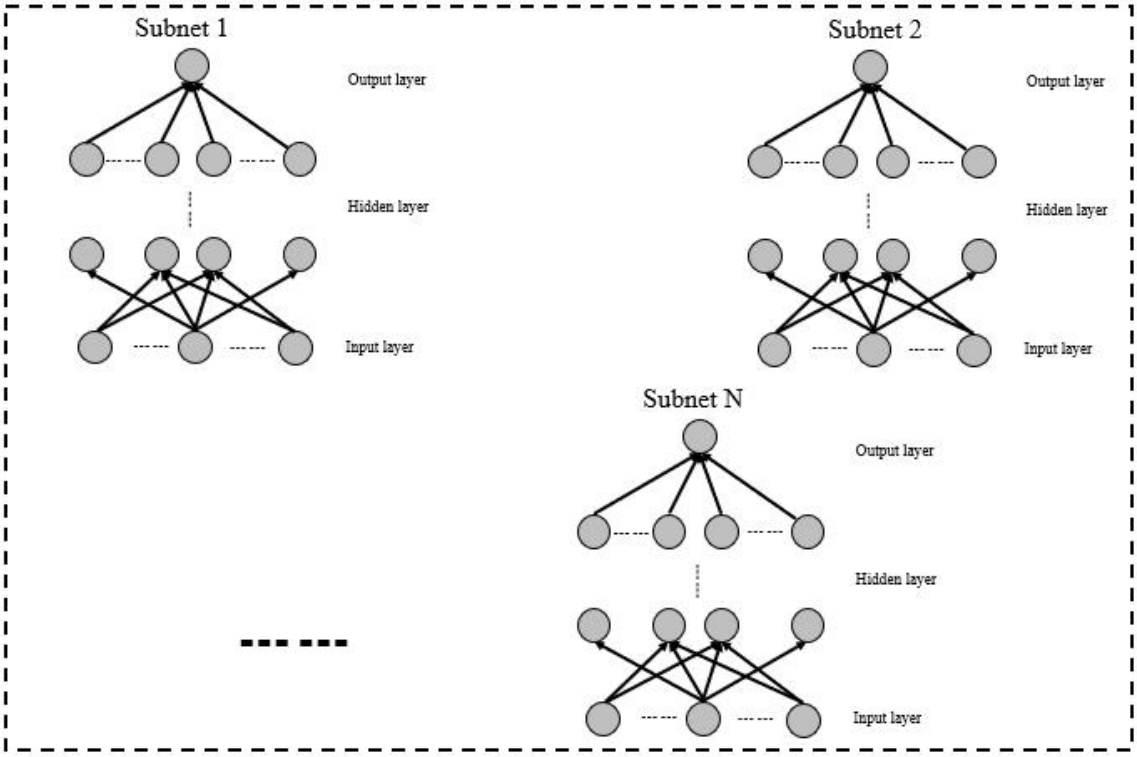

Figure 4: Schematic diagram of network structure

C. Construction of feature extraction model for ceramic decorative painting based on computer data

Convolutional neural network is a type of pre-neural network that differs from the conventional neural network. Periscope neural network consists mainly of winding and soil sample layer. Folding layer usually contains several planar features. Each feature level consists of several neurons and has the same properties on the

level with the total weight of the neurons, which is called the pinnate nucleus. The advantage of weight distribution is that it can reduce the number of connections between neurons and reduce the risk of overconfidence; The next sampling can be considered a special solidification process that can reduce the calculation dimension and improve the comprehensive capability of the model. Folding and scanning greatly simplify the complexity of the model and reduce the model parameters. The training process of the periscopic neural network mainly involves forward and backward transmission. During preparation, the folding layer and the underlying sampling layer were shifted.

The purpose of pre-propagation is the extraction of features, mainly by folding and sampling. The image enters a certain layer from the input layer, and the output value is obtained via the activation function.

$$x^l = f\left(W^l x^l + b^l\right) \tag{1}$$

Including l shift number, w weight, b shift and f activation function in the process of spreading the background, the learning folding method is used to fold the top-level features, and then the new features are obtained through the activation function.

$$x_j^l = f\left(\sum_{i \in M_j} X_i^{l-1} * k_{ij}^l + b_j^l\right) \tag{2}$$

In this formula, l represents the current layer, l-1 indicates the previous layer, x_j^l represents the jth feature map of the current layer k_{ij}^l Represents the convolution kernel corresponding to the ith feature map of the current layer and the jth feature map of the previous layer, b_j^l offset the knurled layer, the scanning layer can ignore the change in the relative position of the target when tilted and rotated, improve algorithm performance and routine, reduce the dimension of the feature map, and avoid simulation to some degree. The calculation method of the following samplers is as follows:

$$x_j^l = f\left(\beta_j^l \operatorname{down}\left(x_j^{l-1}\right) + b_j^l\right) \tag{3}$$

In this formula, down () represents the down sampling function. The purpose of backpropagation is to update the weight of the folding vector, that is, the weight of the folding vector. The loss function in error calculation is usually a square error function The square deviation function of the loss rate indicates for the manifold problems of class c and class N that:

$$E^N = \frac{1}{2}\sum_{n=1}^{N}\sum_{k=1}^{C}\left(t_k^n - y_k^n\right)^2 \tag{4}$$

In this formula, E^N N total sampling error, Represents the t_k^n dimension label corresponding to the n sample and represents the k-th dimension output corresponding to the n sample.

D. Ceramic painting feature extraction convolution neural network structure

The convolutional neural network structure in this paper is shown in Figure 5.

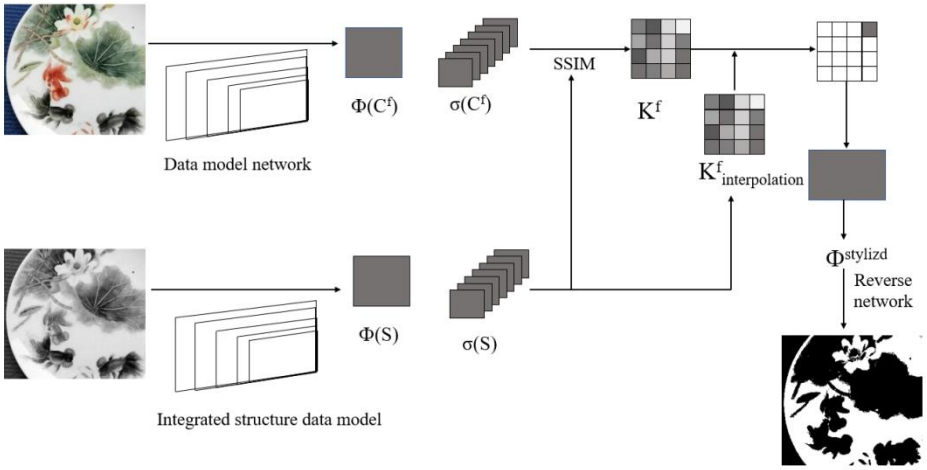

Figure 5: Feature extraction model of ceramic painting based on convolution neural network

It mimics the lateral inhibition mechanism of the biological nervous system and creates a competition mechanism for the activities of local neurons, so that the value with larger response is relatively larger.

E. Design of activation function

a) Basic development of activation function

In recent years, neural networks, especially stacked neural networks, have made great progress, mainly due to a number of key factors, such as the expansion of width and depth of stacked neural networks, the expansion of datasets, support for high-performance hardware such as graphics cards and a variety of unified layer designs. The accuracy of the model is improved to a certain extent. Among them, the activation function is the key of the convolutional neural network.

The activation function used in the traditional neuron model is sigmoid, and its mathematical form is:

$$f\left(y_i\right)=\begin{cases} y_i & y_i \geq 0 \\ a_c \operatorname{SoftSign}\left(y_i\right) & y_i < 0 \end{cases} \tag{5}$$

$$f(x)=1/(1+\exp(-x)) \tag{6}$$

Sigmoid is a widely used active function It has the form of exponential function and is physically closest to biological neurons. In addition, the output (0.1) can represent both the probability and normalization of the input, whereby the loss function of the S-shaped cross entropy is representative. However, there is a serious problem to easily obtain the saturation effect (also known as gradient dispersion effect). In general, the Sigmoid network will output gradients in the area of the fifth floor.

Tanh function is a variation of sigmoid function, and its mathematical form is:

$$f(x)=(1-\exp(-2x))/(1+\exp(-2x)) \tag{7}$$

Tanh function overcomes the disadvantage of non-zero mean output of SIG **-** moid function, has good fault tolerance, and delays the saturation period, but it still does not solve the gradient disappearance problem.

Softsign function is similar to hyperbolic tangent function, and its mathematical form is:

$$\mathrm{f(x)=x\ /(1+a\ b\ s(x))} \tag{8}$$

Compared with the hyperbolic tangent function, the SoftSign [23] activation function has a smoother asymptote, and compared with the hyperbolic tangent function, the activation value of the SoftSign activation function is not oversaturated within the network layers 1～4. Experiments show that softsign activation function has better effect on image classification accuracy than hyperbolic tangent function.

The appearance of ReLU function greatly promotes the development of neural networks.

ReLU [24] is a piecewise linear function. Its positive half axis input and output are consistent, and the negative half axis input is always zero. This form can alleviate the gradient disappearance phenomenon. However, with the gradual progress of training, the corresponding weights of the input values falling into the hard saturation zone will not be updated, and thus the phenomenon of neuron death will occur. Another outstanding problem of relu is that the output will be offset, that is, the average value of the output is always greater than zero. Therefore, this paper considers the advantages of several activation functions to improve them.

b) Improved activation function

Two points should be paid attention to when neural network selects activation function: ① avoid over saturation of activation function; ② Avoid over linearization of the activation function. Compared with Re-LU SoftSign function makes the neural network have nonlinear characteristics and can learn better; Compared with SoftSign, ReLu function plays a greater role in the network training process, can alleviate the gradient disappearance phenomenon, and the convergence speed is faster.

Combine the advantages of SoftSign and ReLU functions to build a new activation function

Number, named SReLU. The activation function is defined as follows:

$$f\left(y_i\right)=\begin{cases} y_i & y_i \geq 0 \\ a_c \operatorname{SoftSign}\left(y_i\right) & y_i < 0 \end{cases} \tag{9}$$

In this formula, yi is the input of the i activation function f. when the input of the activation function layer is greater than 0, the value of the ReLU function is taken; conversely, when it is less than 0, the value of the hyperbolic tangent function is taken. PReLU [25], Subscript c represents different channels of picture color, and ac represents the value of different color channels, controlling the negative half axis input. If ac=0, SReLU degenerates to ReLU. Srelu has a negative value compared to ReLU, bringing the average value of activation

closer to 0. The non-zero mean output can accelerate the learning speed because its gradient is closer to the natural gradient. SreLU activation function is shown in Figure 6.

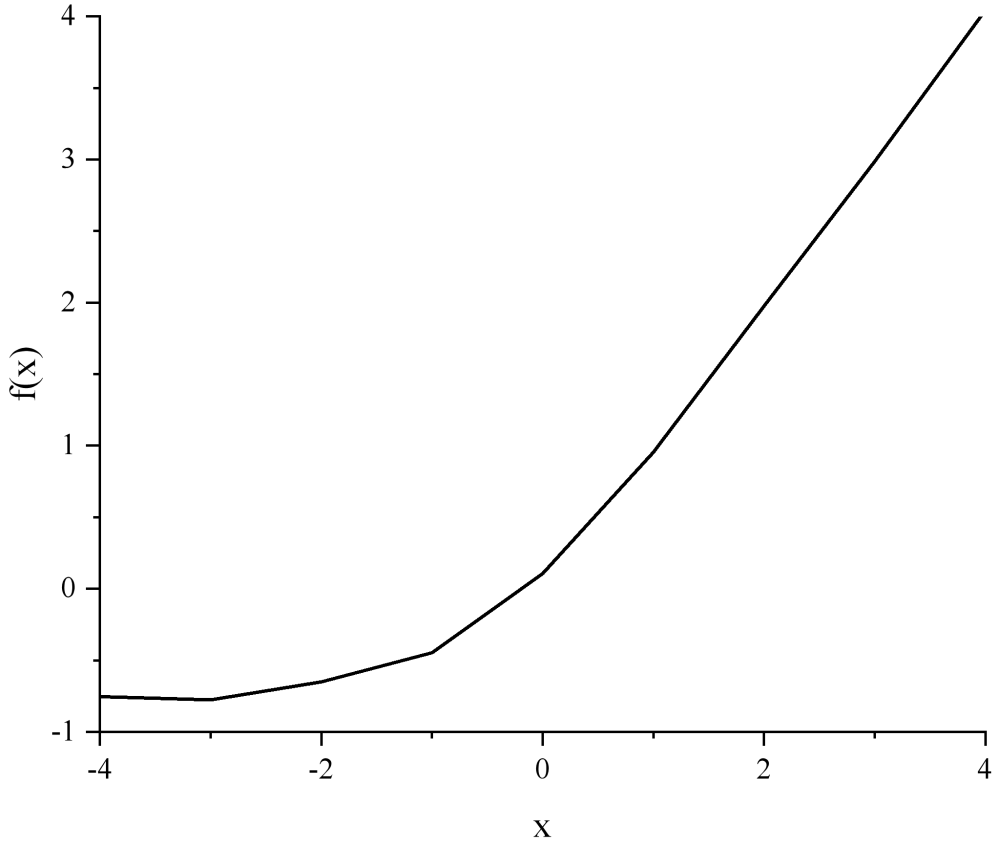

Figure 6: improved activation function diagram

The parameter ac of SReLU activation function can be back propagated to be optimized. The parameter update follows the chain derivation rule. The ac gradient optimization formula is as follows:

$$\frac{\partial \varepsilon}{\partial a_c} = \sum_{y_i} \frac{\partial \varepsilon}{\partial f(y_i)} \frac{\partial f(y_i)}{\partial a_c} \tag{10}$$

Among them, ε represents an objective function, $\frac{\partial f(y_i)}{\partial a_c}$ Represents the gradient of the current layer. The gradient calculation method of SRE-LU current layer is as follows:

$$\frac{\partial f(y_i)}{\partial a_c} = \begin{cases} 0 & y_i \geq 0 \\ y_i / (1 - y_i) & y_i < 0 \end{cases} \tag{11}$$

V. CASE ANALYSIS OF CERAMIC PAINTING FEATURE EXTRACTION FROM COMPUTER DATA MODEL

Comparative experiment and analysis: the experimental environment is win10 operating system with Intel i7 2.9ghz CPU and 16GB RAM memory. The experiment is conducted with Python 3.6 and TensorFlow deep learning framework.

(1) The classification effect of the proposed algorithm on ceramic decorative painting image data

This section mainly verifies the classification effect of the proposed algorithm on 1015 ceramic decorative painting images, i.e. Jiangnan Water Town (JNSX), figures (RW), flowers and birds (HN), ancient trees (GS) and ink painting (SM). The characteristic classification matrix heat of five ceramic painting styles is shown in Figure 7.

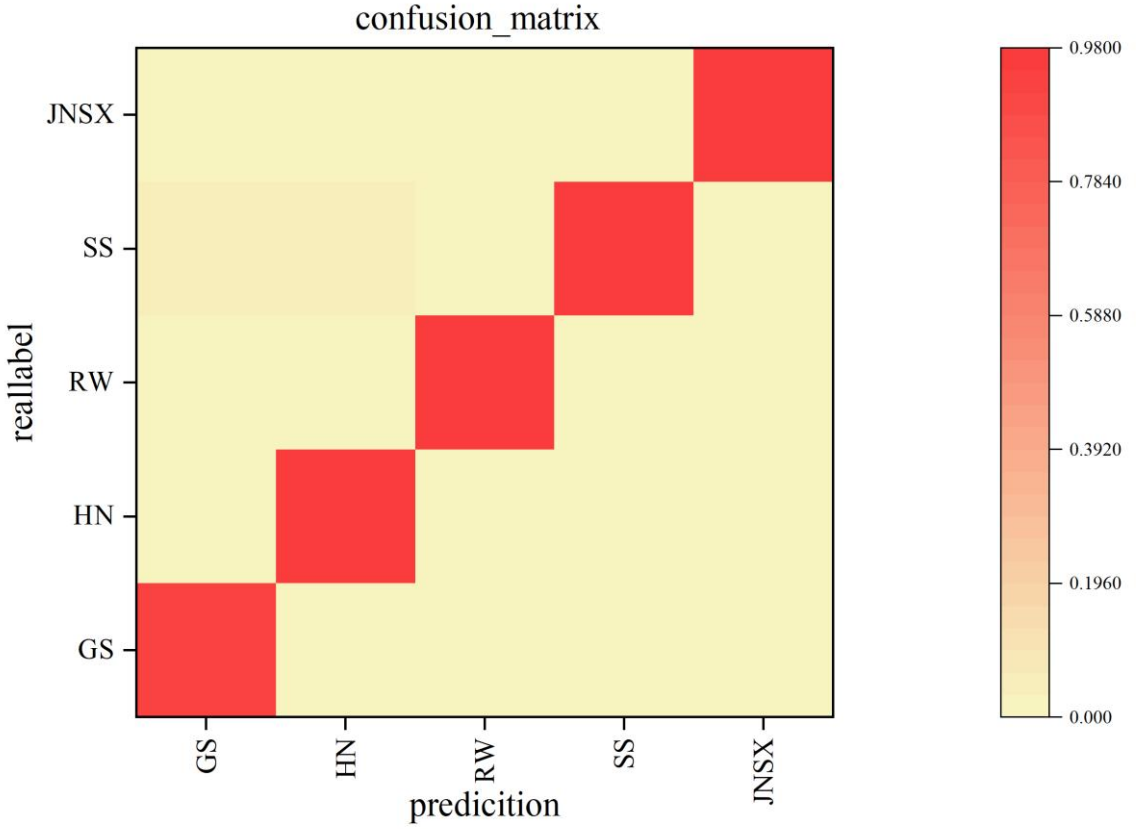

Figure 7: characteristic classification matrix heat map of five ceramic painting styles

Analyzing this figure, it is found that the classification accuracy of ancient tree paintings is lower than that of other ceramic decorative paintings, but on the whole, it can be effectively distinguished.

(2) Ablation Experiment

In order to verify the effectiveness of parallel network and adaptive weighted fusion layer in the proposed algorithm, ablation experiments were performed.

Compare the classification accuracy of CNN only using convolutional neural network model on CP image data set, LSTM that converts images into sequences and inputs them into long-term and short-term memory network model, scnn-lstm that uses concatenation method to fuse CNN and LSTM features, and acnn-lstm that uses adaptive weighting method to fuse CNN and LSTM features, as shown in Figure 8.

The experimental results shown in the figure above show that the accuracy of this algorithm is 1% higher than that of the CNN method and 15% higher than that of LSTM with only partial properties. This is because the proposed algorithm can capture the global and local characteristics simultaneously to verify the effectiveness of parallel networks. In addition, the accuracy of integrating CNN and LSTM properties using series is low. This is because the sequential integration method increases feature redundancy and affects the classification effect. The weighted integration method proposed in this paper reduces the feature dimension, enriches the feature categories, improves the efficiency of the algorithm and checks the effectiveness of the algorithm.

(3) Comparison of the algorithm effect with other classification methods

As shown in Table1, the proposed algorithm is compared with the corresponding comparison methods of the four indicators described in the previous section.

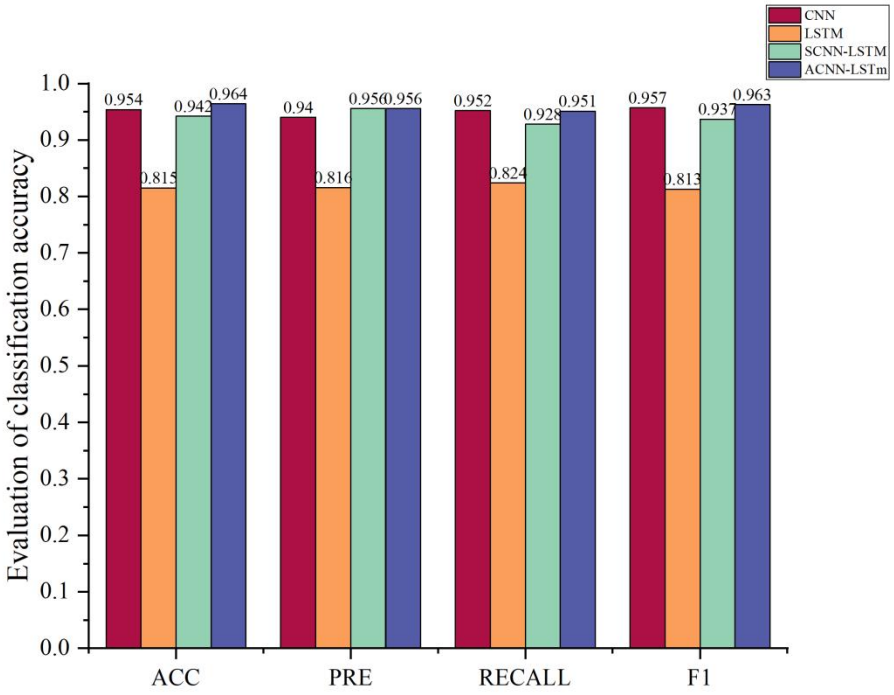

Figure 8: Ablation experimental results.

Table 1: Comparison of table related methods in ceramic decorative painting data set

	Method	Accuracy	Precision	Recall	F1
Non deep learning method	SIFT-DNN	0.898	0.836	0.879	0.897
	SIFT-Bow	0.869	0.880	0.872	0.889
	CECC	0.662	0.687	0.681	0.679
	CTCP	0.667	0.711	0.682	0.673
	KSRC	0.831	0.783	0.844	0.805
Deep learning method	DCT-CNN	0,936	0.942	0.945	0.939
	SH-CNN	0.947	0.941	0.940	0.949
	ACNN-LSTM	0.961	0.956	0.951	0.964

Compared to classical traditional methods and deep learning methods, the first five points are based on flat properties, including sift NDD, sift bow, CTCP and KSRC. The last four lines are DCT-CNN or DCT-CNN. SH-CNN, based on the in-depth investigation of extraction properties.

From the experimental results of these algorithms it can be concluded that the traditional method has the best effect on the accuracy index (89.96%) instead of 90%. The accuracy of deep learning and CNN exceeds 90%. The experimental results show that the classification algorithm based on CNN and LSTM has the highest accuracy of 96% in the ceramic decorative paint data set, confirming the effectiveness of the experiment.

VI. CONCLUSION

This paper analyzes the development of ceramic decorative painting and the basic principle of computer data model, determines the combination of ceramic decorative painting and computer data model, and establishes a computer data model for feature extraction of ceramic decorative painting. The computer data model proposed in this paper captures the overall style features of ceramic decorative painting through the global convolution neural network, and not only extracts the detailed features of local painting through the Bureau short-term memory artificial neural network, but also mines the dependency relationship between different regions in the image, and obtains the dependency information of local specific positions on the whole ceramic decorative painting image. Get the most significant characteristics that can represent the local description of ceramic decorative painting. Then the two features are fused by adaptive weighting strategy to reduce redundancy and improve classification efficiency. The experimental results show that the best classification effect is achieved on the self built ceramic decorative painting image database of 1015 images of five categories. When compared with the traditional classification algorithm based on non deep learning and the partial classification algorithm based on deep learning, the average F1 value of this hybrid neural network model is 96.4%, which is 1.5% higher than the best

traditional model. This shows that the designed computer data model has obvious advantages in feature extraction of ceramic decorative painting.

Data Availability

The experimental data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

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