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Research Article

Interoperability Analysis between Traditional Chinese Sculpture and Painting Modeling from the Perspective of Big Data Management

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Chinese traditional sculpture and painting have strong interoperability in terms of patterns, colors, and lines. Chinese sculpture and painting art are traditional Chinese works of art. The art of painting is often the basis for sculptural art. A good sculptural work of art often requires the pattern and color foundation of the painting. Moreover, Chinese traditional sculpture artworks often reflect certain historical information and humanistic spirit. Traditional artificial methods are often difficult to discover the intercommunication between cultural information between Chinese sculpture and painting. For the interoperability between sculpture and painting artworks, artists only rely on professional knowledge and aesthetic ability to discover some interoperability in patterns, colors, and lines, which is insufficient for understanding Chinese sculpture and painting. This study designs a novel hybrid CNN-LSTM method to study the interoperability of Chinese sculptures and paintings in terms of patterns, colors, lines, and cultural information. CNN can extract patterns, colors, and line features of Chinese paintings and sculptures. The cultural characteristics of Chinese sculptures have obvious temporal characteristics, which can be mined by LSTM technology. The research results show that the hybrid CNN-LSTM method has good feasibility and accuracy in studying the interoperability of traditional Chinese sculpture and painting. In terms of average error, the largest error is only 3.03% and this part of the error comes from the prediction of Chinese sculpture and painting cultural information. All other features of traditional sculpture and painting are predicted to be within 3%. For the prediction of color features, the error is only 1.13%. Prediction errors for patterns, colors, and lines are within acceptable limits.

1. Introduction

In the development of Chinese art history, sculpture and painting are the two most charismatic and artistic works of art. The development of traditional Chinese sculpture is inseparable from the support of paintings and works of art, and the preproduction process of Chinese sculpture is also inseparable from the support of the colors and patterns of paintings [1, 2]. In the development process of ancient Chinese art, artists often entered the study of sculpture products through painting and then returned to the study of painting works, which reflected the close connection between Chinese sculpture and painting works. For traditional Chinese sculpture, its production process often begins with painting [3]. It first paints according to the artistic information and cultural information that the sculpture needs to reflect, and then the engraver sculpts according to the content of the painting. Sculpture art tends to last longer than painting artworks, and it can generate more long-term historical information [4, 5]. There are obvious differences between the characteristics of traditional Chinese sculpture and Western sculpture. Western sculpture pays more attention to the connotation of color and pattern, which is similar to the characteristics of painting. However, Chinese traditional sculpture also pays attention to the characteristics of historical information culture and human spirit. Chinese traditional sculpture not only reflects the color and pattern information of painting, but most Chinese sculptures will convey a spiritual connotation and historical and cultural information. Line is also an important means of Chinese

painting, and Western painting often ignores the change of line [6, 7]. There are also obvious line changes in Chinese traditional sculpture works, which further illustrates the interoperability between Chinese traditional sculpture and painting. The interoperability of Chinese sculpture and painting is also an aspect to improve the artistic characteristics of sculpture and painting. Traditional methods rely solely on artistic features such as color, pattern, or linearity to identify the interoperability between traditional Chinese sculpture and painting. For the connotative information of Chinese sculpture or painting, traditional methods are often difficult to identify these interoperability. Big data technology has certain advantages in processing complex data, and it can try to identify the interoperability between traditional Chinese sculpture and painting.

With the continuous advancement of global technology, a huge amount of data will be generated in life. There is a certain correlation between these data. If these data are used well, it will better guide people's life and production activities. Big data technology is an excellent product for processing complex data, and it is also a product under the background of the rapid development of computer performance [8, 9]. Big data technology can use superior algorithms to discover correlations and complex relationships between data. These relationships are often difficult to discover by people relying on experience or expertise. Big data technology has been widely used in the 21st century. It can help traffic control traffic lights, and it can help medical staff perform surgeries [10, 11]. However, the core of big data technology is a large amount of data, which is also the premise of big data's learning ability. Now, there are many algorithms and mathematical knowledge that can extract data from pictures or video information, which also expands the use of big data technology. It can not only be used in the fields containing data information but also be better used in the fields of pictures, videos, and voices. Similarly, Chinese sculpture or painting art can also extract huge amounts of data, which can also be extracted by big data technology [12, 13]. Big data technology can process data related to space, time, and environment [14]. Convolutional neural network (CNN) technology can handle spatial features very well. Long short-term memory (LSTM) neural network can better extract the temporal features of data. Reinforcement learning can handle data variables related to the environment. This shows the powerful data processing capability of big data technology, and the scope of use of big data technology is also relatively wide.

The fusion of Chinese sculpture and painting art with big data will discover more potential features. Chinese sculpture and painting art can be converted into data, and big data technology can discover the correlation between Chinese sculpture and painting, which can better guide it to discover the correlation between Chinese sculpture and painting, which is not only limited in color, pattern, and line. CNN technology can be used to extract color, pattern, line, and cultural information features between Chinese sculptures and paintings, and it may find more highly correlated features than traditional artificial methods. This is helpful for comparing the interoperability between Chinese sculpture and Chinese painting. The cultural information features between traditional Chinese sculpture and painting are features that are obviously related to time. It can use LSTM technology to discover the time-related features of Chinese sculpture and painting.

This research mainly solves the disadvantage that traditional artificial methods cannot effectively discover the interoperability between Chinese sculpture and painting. It uses CNN and LSTM methods in big data technology to design a hybrid CNN-LSTM method to study Chinese sculpture and painting. This study mainly analyzes and studies from five aspects. Section 1 presents the background of traditional Chinese sculpture and painting as well as the development background of big data technology. The research status of Chinese sculpture and painting is analyzed in Section 2. Section 3 introduces the application of hybrid CNN-LSTM in analyzing the interoperability of traditional Chinese sculpture and painting, and it also introduces the principles of CNN and LSTM algorithms. Section 4 is the focus of this study, which introduces the feasibility and accuracy of the hybrid CNN-LSTM algorithm in analyzing the color, pattern, linearity, and cultural information of Chinese sculptures and paintings. Section 5 provides guidance and conclusions for studying the interoperability between Chinese sculpture and painting.

2. Related Work

Since ancient times, there has been a strong correlation between traditional Chinese sculpture and painting, in terms of color and pattern. Sculpture is also a way of inheriting history and culture. Many researchers have conducted more research on the structure and materials of sculpture. Angeles and Alberto [15] believed that glass-type sculpture products have high artistic value and aesthetic diversity. He analyzed binomial glass sculptures and the pattern information of glass sculptures. He also introduced some influences of historical evolution on glass sculpture patterns, and it also took into account the influence of production technology on glass sculpture artworks. Through these analyses, it can be seen that glass sculpture also carries important artistic value and historical and cultural information, which is also an important aspect of sculpture. Du [16] has found that there is a certain instability in the traditional sculpture production method, which is also closely related to the level of the sculptor. He used multi-coordinate CNC machine tool technology and computer three-dimensional modeling technology to study the production method of sculpture. It also studies how the sculpture is made using edge computing methods and 3D image reconstruction techniques. The research object used in this study is human sculpture feature data, which fully researches portrait sculpture technology by using edge computing method. The research results show that this method can design sculptures from multiple angles and dimensions, and it has higher efficiency and higher scalability. Liu and Zhang [17] use visual sensing technology and three-dimensional reconstruction technology to study the structure and restoration technology of ice sculptures,

and it also uses these two technologies to explore the artistic characteristics contained in ice sculptures. Ice sculptures designed based on 3D reconstruction technology and visual sensing technology are compared and analyzed with artificially tested sculptures. The results of the study show that these two methods are feasible in the process of ice sculpture repair and construction. Compared with traditional artificial techniques, it has higher efficiency and higher stability. This method also ensures stability during the construction of the ice sculpture. Zhou and Gao [18] have explored the use of computer graphics in the creation of public sculptures. It uses 3D laser scanning technology and cloud models to explore the shaping and construction methods of public sculptures, which also involves the research process of algorithms. The statistical outlier removal algorithm is utilized in the process of processing point clouds. The findings suggest that the fusion of computer graphics technology and public sculpture can improve the efficiency and accuracy of work. Computer graphics technology enables high-resolutions culptural artwork, which improves the integrity and accuracy of public sculpture. Bordalo et al. [19] used infrared thermal imaging (IRT) technology to analyze the indication of the plaster sculpture and the anomalies of the internal structure, which will be beneficial to the protection of the sculpture. Gypsum sculpture is a widely used sculpture material. However, gypsum sculpture is greatly affected by the environment, which affects the transmission and preservation of historical and cultural information and painting information contained in the sculpture. This study investigates the structure and preservation techniques of plaster sculpture art using IRT active imaging technology. This technology will be beneficial to the preservation and circulation of sculptures made of gypsum materials, which is also a kind of protection for the historical and cultural information contained in the sculptures. Song and Zhong [20] study the artistic value as well as the technological value of interactive urban sculpture. He has found that urban sculpture has incorporated more technological elements, which makes urban sculpture gradually move from the traditional static artistic value to the direction of technology and intelligence. This urban sculpture increases the interaction between people and sculpture. However, he lost more elements of the painting itself. He analyzed and designed interactive models of sculptures using augmented and virtual reality technology. Wang and Ni [21] study the relationship between public sculpture and art using the artificial fish swarm algorithm (AFSA). The AFSA is used to construct the ecological and spatial pattern of public sculpture, which will construct a sculpture between art, environment, and people. At the same time, it uses remote sensing technology to accurately predict and analyze the sculpture landscape data. From the above literature review, it can be seen that the researchers mainly studied the structure and protection methods of the sculpture itself. The interoperability between Chinese traditional sculpture and painting is less studied. There is also less research on big data technology in sculpture. The purpose of this study is to change the traditional way of manually evaluating the interoperability of sculpture and drawing. It uses a hybrid CNN-LSTM to analyze the interoperability between the two from the perspective of color, pattern, line, and cultural information. The CNN-LSTM method can not only extract the spatial features of the interaction between traditional Chinese sculpture and painting, but also better reflect the temporal correlation between the interactions between traditional sculpture and painting.

3. The Application of Big Data in Interoperability of Sculpture and Painting

3.1. The Significance of Hybrid CNN-LSTM Algorithm. Big data technology includes CNN and LSTM algorithms. In this study, a novel hybrid CNN-LSTM neural network is designed using CNN and LSTM methods. It can deal with the temporal characteristics of sculpture and painting, and it can also deal with the spatial characteristics of sculpture and painting. This research mainly studies the intercommunication between Chinese traditional sculpture and painting from four aspects: pattern, color, line, and cultural information of sculpture and painting. The data of patterns, colors, and lines are in the form of pictures or three-dimensional. The traditional artificial method only uses aesthetic ability and professional knowledge to judge the interoperability between Chinese sculpture and painting through colors and pattern subjectivity. The CNN-LSTM method will come from the data perspective, and it can find the connection between sculpture data and painting data. CNN-LSTM neural network is a hybrid neural network that combines CNN and LSTM methods. It takes full advantages of the CNN in extracting spatial features and the advantages of LSTM in extracting time. The amount of sculpture data and painting data is huge, and it is difficult to process these data manually. Big data technology has certain advantages in processing sculpture processing and painting data.

3.2. System Design for Interoperability Research of Sculpture and Painting. This research will use the hybrid CNN-LSTM algorithm to fully mine the characteristics of pattern, color, linearity, and cultural information of sculpture and painting data, which provides data support for the study of the interoperability between Chinese traditional sculpture and painting. CNN is used to process the spatial features of patterns, colors, and lower lines of sculptures and paintings, and LSTM is used to extract temporal features of sculptures and paintings. The CNN algorithm can also achieve mapping the relationship between sculpture data and painting data. Once the relationship between input and output is determined, researchers can issue the interoperability between traditional Chinese sculpture and painting. This can also guide the design of sculptures through the art of painting. Figure 1 shows the system design for a sculpture-painting interoperability study utilizing a hybrid CNN-LSTM algorithm. The relevant feature data of traditional Chinese sculpture and painting will be converted into feature values between 0 and 1, and it will input the data of the input layer into the CNN layer. The data related to the sculpture pattern, color, linearity, and cultural information will be used as the input data of the CNN-LSTM algorithm, and these data will

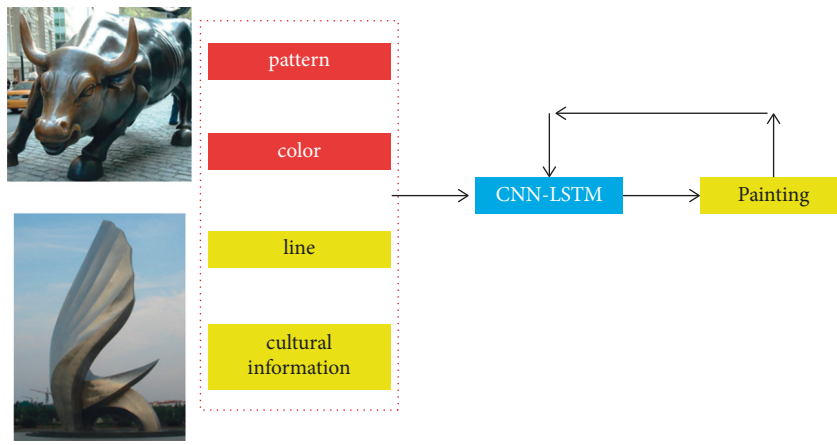

Figure 1: The interoperability research system design using CNN-LSTM algorithm.

go through the feature extraction stage of the CNN and LSTM algorithms. After the features of the sculpture data are extracted, it will use a nonlinear activation function to map the relationship between painting patterns, colors, lines, and cultural information. The relationship between sculpture and painting-related data is expressed in the form of weights and biases, which is not an intuitive functional relationship. This system design scheme also has a feedback mechanism, which continuously operates with real data, which can also find the optimal mapping relationship.

Through the system design scheme in Figure 1, it can be found that the characteristic information such as pattern and color of the sculpture will first pass through the CNN algorithm. Figure 2 shows the workflow of the CNN algorithm. The CNN algorithm can not only complete the task of sculpture feature extraction, but also reduce the amount of parameter computation. In Figure 2, a Conv structure will consist of a convolutional layer and a pooling layer. These are all network layers used for feature extraction. Current neural network methods allow for deeper network layers, thanks to the rapid development of CNN technology. The traditional fully connected neural network has the disadvantage of a huge amount of parameters, which affects the application of large datasets in neural network methods. This disadvantage is better addressed by the CNN method.

The patterns, colors, lines, and cultural information data of sculptures and paintings will be used as the input data of CNN. However, these data need to be processed by matrix, and the image information is processed into the form of matrix. This form of data does not result in poor predictions due to the resolution of the images. Equations (1)–(3) show the representation of the training set, test set, and prediction results, respectively. In this study, the input of the training set is the data related to traditional Chinese sculpture. The output of the training set is the relevant data for the painting features. The data composition of the test set is the same as that of the training set.

$$\text{Train} = \{(x_1, y_1), (x_2, y_2), \ldots.., (x_n, y_n), \ldots.(x_N, y_N)\}, \tag{1}$$

$$\text{Test} = \{(x_1, y_1), (x_2, y_2), \ldots.., (x_m, y_m), \ldots.(x_M, y_M)\}, \tag{2}$$

$$\widehat{y} = \left\{\widehat{y}_1, \widehat{y}_2, \ldots\ldots, \widehat{y}_m, \ldots\ldots.., \widehat{y}_M\right\}. \tag{3}$$

From Figure 1, it can be found that there is a feedback mechanism in the method designed in this study to study the interoperability of sculpture and drawing. This is also the result of the feedback mechanism of the hybrid CNN-LSTM algorithm. The feedback mechanism is the process of making an error between the predicted value of the painting data and the actual value. (4) shows the process of error calculation. In this study, the mean square error was used for the calculation. (5) shows the explicit computational form of

$$E = \frac{1}{2}\left\|d - y^L\right\|_2^2, \tag{4}$$

$$E = \frac{1}{2}\sum_{k=1}^{m}\left[d_k - f\left(\text{net}w_k\right)\right]^2 = \frac{1}{2}\sum_{k=1}^{m}\left[d_k - f\left(\sum_{j=0}^{n}\omega_{jk}y_j\right)\right]^2. \tag{5}$$

Many hyper-parameters are involved in the calculation process of CNN, and the choice of hyper-parameters will affect the degree of convergence of the network and the accuracy of the calculation results. There is also a relationship between these hyper-parameters, and (6) shows the relationship between the hyper-parameters. (7) shows how the input layer of the CNN is calculated, which contains the weights and the relationship between the input data. In equation (6), p represents the fill step size. k represents the number of filters, and it can choose 64 or 128. s represents the sliding step.

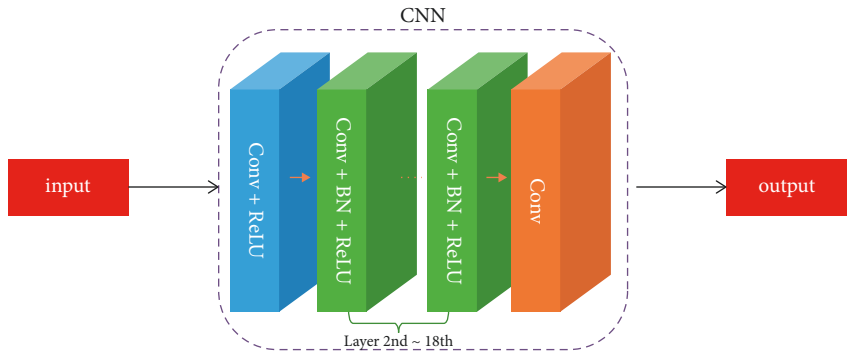

Figure 2: The workflow of CNN algorithm.

$$w' = \frac{(w + 2p - k)}{s} + 1, \tag{6}$$

$$x_j = f\left(\sum_{i \in M_j} x_i^{\zeta-1} * k_{ij}^{\zeta} + b_j^{\zeta}\right). \tag{7}$$

In this study, the method of gradient descent is used to find the optimal weights and biases. Gradient descent is the calculation process of the derivation of weights and biases. (8) shows how the weights are derived.

$$\frac{\partial E}{\partial k_{ij}^{\zeta}} = \sum_{u,v} \left(\delta_j^{\zeta}\right)_{uv} \left(p_i^{\zeta-1}\right)_{uv}. \tag{8}$$

3.3. The Introduction and Design of Hybrid CNN-LSTM Algorithm. The cultural information data of sculptures and the cultural feature information data of paintings contain certain temporal features, which are not enough for feature extraction only by using the CNN method. If only the CNN method is used to extract the feature data of sculpture and painting, it will cause inaccuracy in the prediction of information data. This study adopts a hybrid CNN-LSTM method to map the relationship between sculpture data and painting data. Figure 3 shows the workflow of the hybrid CNN-LSTM approach. This study organizes the data of the CNN output layer, which will be organized into a time series form. This data form will serve as the input data for the LSTM neural network. The pattern, color, linearity, and cultural information data of sculptures are used as input data for the CNN-LSTM method. After it goes through the feature extraction of CNN, the data will be input into the network layer of LSTM. LSTM further extracts the features of patterns, colors, lines, and cultural information of sculpture data. These data will be mapped with the patterns, colors, lines, and cultural information of the paintings. The label data of these feature data of the painting are used as the feedback data of the hybrid CNN-LSTM layer. The LSTM neural network method mainly includes forget gate, input gate, refresh gate, and output gate. It can selectively process historical state information by assigning different weights.

The main advantage of the LSTM method is to extract the temporal features of sculpture data as well as painting data, which is due to the existence of more gate structures. The gate structure can selectively input information according to the weight. The forget gate is the key to LSTM ability to process time series information. It can assign weights to historical state information, and the forgetting gate will selectively input historical information, which ensures that it has time characteristics. (9) shows how the forget gate is calculated.

$$C(t) = C(t-1) + g_{in} \otimes \widetilde{C}(t). \tag{9}$$

(10) shows the calculation method of the input gate of the LSTM layer, which will give different weights to the historical information and the information of the sculpture and painting of the current state. It will selectively pass part of the feature information of sculpture and painting according to the weight.

$$i_t = \sigma\left(\omega_i \bullet \left[h_{i-1}, P_t\right] + b_i\right). \tag{10}$$

In general, an LSTM has multiple layers, and the output layer of the LSTM will be connected to the input gate of the next layer. The output gate can control the output of historical information and current state information. (11) shows how the output gate is calculated.

$$O_t = \sigma\left(w_o \bullet \left[\overrightarrow{h}_{t-1}, P\right]_t + b_o\right). \tag{11}$$

4. Result Analysis and Discussion

The goal of this study is to use a hybrid CNN-LSTM method to achieve the mapping of patterns, colors, lines, and cultural information factors in sculpture and painting. Through these mapping relationships, researchers can discover the interoperability of traditional Chinese sculpture and painting in these four characteristics. This study selects various types of sculpture data and painting data in China as the dataset for this study. Figure 4 shows the prediction error of Chinese sculpture and painting in four different aspects using the hybrid CNN-LSTM method. In general, the hybrid CNN-LSTM method can better predict the pattern, color, linearity, and cultural information of sculpture and painting, which is beneficial for understanding the interoperability between traditional Chinese sculpture and painting. In patterns, colors, lines, and cultural messages in sculpture and

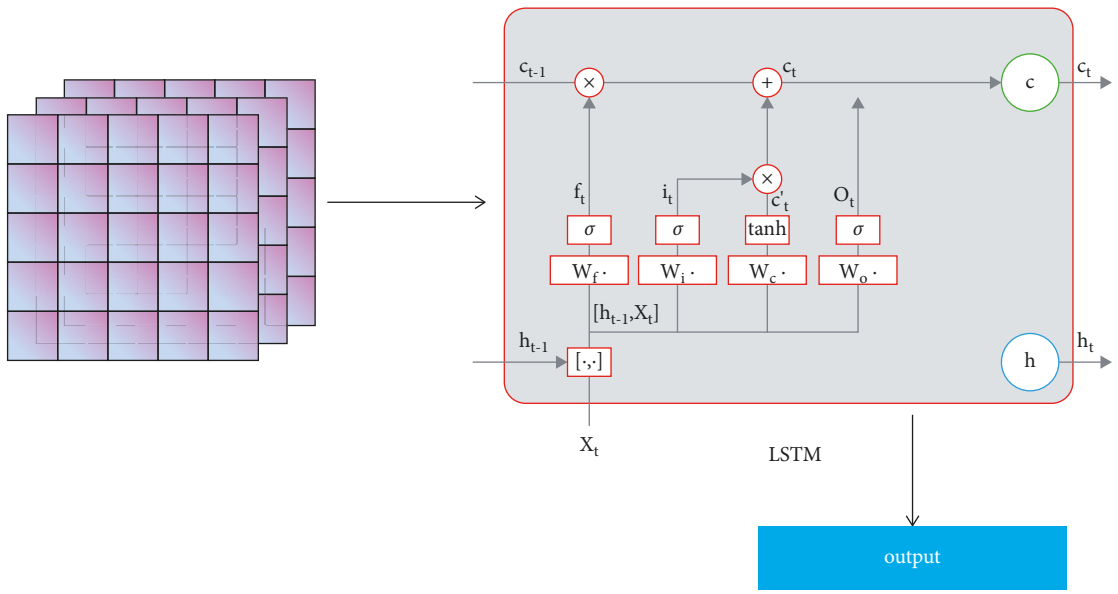

Figure 3: The workflow of hybrid CNN-LSTM algorithm.

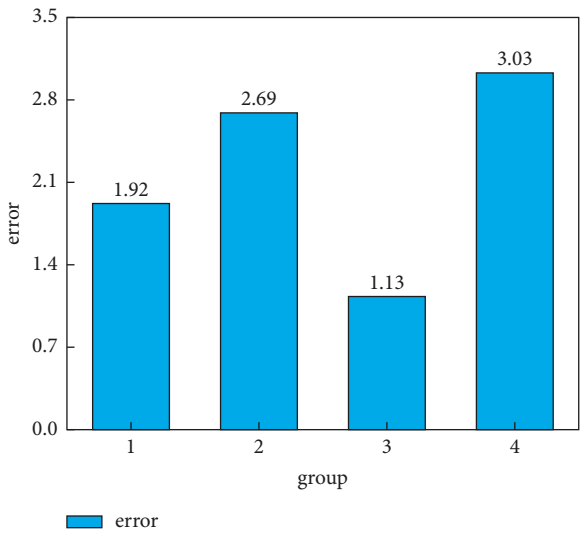

Figure 4: Prediction errors of four correlative factors for sculpture and painting.

painting, cultural information is the most difficult to predict. The prediction error of this part is 3.03%. Although this part of the error is relatively large, it is also within an acceptable error range. This is because cultural information has more time characteristics and historical factors, which makes it difficult to predict cultural information. The smallest error is only 1.13%, and this part of the error comes from the prediction of the color information factors of sculpture and painting. The prediction error of linear information is only 1.92%, and the prediction error of pattern information is 2.69%. Judging from the prediction errors of four aspects of sculpture and painting, the hybrid CNN-LSTM method has better performance in studying the interoperability of Chinese sculpture and painting.

Pattern feature is an important factor in evaluating the interoperability between sculpture and painting, because the pattern of painting will affect the design of sculpture. This study matrixed data on the pattern features of sculptures. Although the sculpture is an irregular body, these pattern data can be processed into a regular data form. Figure 5 shows the distribution of prediction errors for the pattern features of sculpture and painting. Overall, most of the prediction error values for sculpture and painting patterns are within 3%. Only a few prediction errors exceed 3%, which further shows that the hybrid CNN-LSTM method has better accuracy in predicting the pattern features of sculpture and painting. This provides data support for evaluating the interoperability of sculpture and painting. It can also be seen from Figure 5 that the prediction error in the lower part is relatively small, and the error distribution in the lower part is relatively uniform. There is a large error in the upper part, and there is a certain error gradient in this part of the error. This error distribution also better shows the distribution of painting in sculpture art. Generally speaking, there is a smaller pattern gradient in the lower part of the sculpture. The pattern on the upper part of the sculpture is relatively complex. However, overall, the pattern error distribution obtained by the hybrid CNN-LSTM is also within an acceptable range.

In order to further demonstrate the advantages of the hybrid CNN-LSTM method in predicting the features of sculpture and painting patterns, this study discretizes the upper part of the pattern to obtain the curve in Figure 6. Figure 6 shows the trend curve of the prediction error of sculpture and painting. The red curves represent the predicted data values of the pattern features of sculpture and painting, and the blue curve represents the actual value of the pattern features of sculpture and painting. The yellow area refers to the distribution of errors between predicted and actual values. It can better reflect the actual distribution of errors among different data. In general, the predicted value of the pattern feature is in good agreement with the change

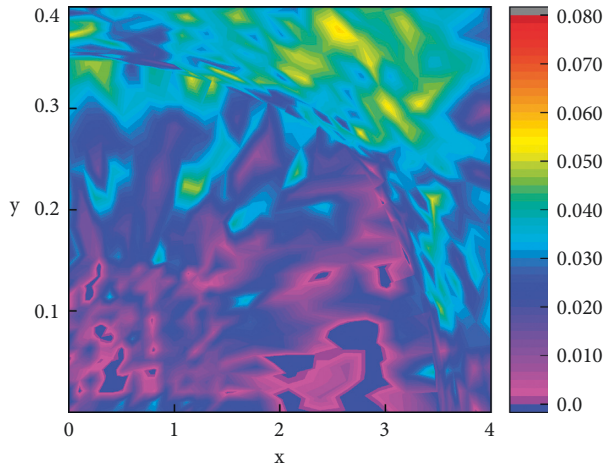

Figure 5: The prediction errors of pattern features in sculpture and painting.

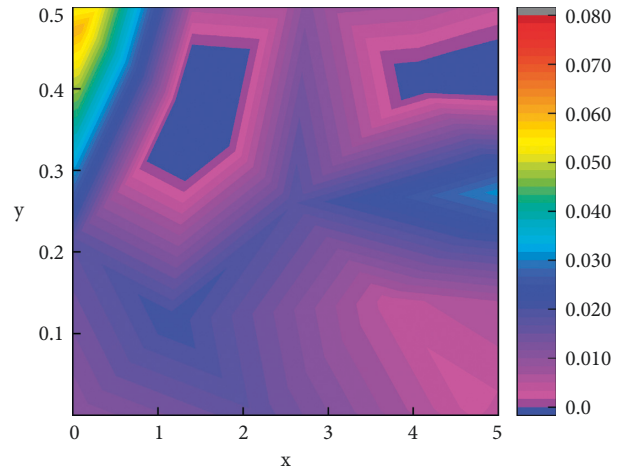

Figure 7: The prediction error of color features in sculpture and painting.

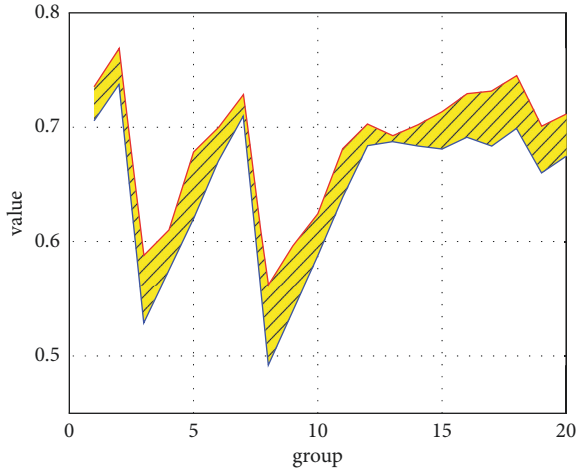

Figure 6: The sculpture and painting pattern features predicting curve trends.

trend of the actual pattern feature data value. At the same time, the peak and trough values of the pattern features are in good agreement with the actual values. The yellow area is the error distribution between the predicted value and the actual value. It can also be seen from Figure 6 that the change trend of the error distribution is relatively uniform. This illustrates the accuracy and stability of the CNN-LSTM method in predicting the pattern features of sculpture and painting, which is trustworthy data for understanding the interoperability of sculpture and painting.

Color characteristics are also important characteristics in sculpture art, which can reflect the meaning conveyed by sculpture and painting. If the color characteristics of sculpture and painting can be effectively predicted, it is helpful to understand the content of sculpture and painting. Figure 7 shows the distribution of prediction errors for the color features of sculptures and paintings. Compared with the prediction error of pattern features, this part of the error is relatively small, and the error distribution in most areas is within 3%. It does not have a large error distribution gradient like the prediction error of pattern features. For the color characteristics of sculpture and painting, it only has a large error in the edge area, and the error distribution in other areas is relatively small and uniform. From the distribution of color errors in Figure 7, the hybrid CNN-LSTM method has high accuracy in predicting the data of color features of sculpture and painting. Higher accuracy can more efficiently help researchers understand the interoperability between painting and sculpture in terms of color.

Among the four characteristics of sculpture and painting, cultural information is the most difficult to find through traditional artificial means. There is also a subjective awareness of the artificial method, which creates a big difference for different sculptures and paintings. Therefore, the prediction accuracy of cultural information features is the most important criterion for studying the interoperability of sculpture and painting. Figure 8 shows the distribution of predicted and actual values of cultural information features of sculpture and painting. The abscissa represents the test set of 20 groups of cultural characteristics selected in this study. The y-coordinate represents two variables, the actual value and the predicted value. The z-coordinate represents the numerical magnitude of the cultural trait. In general, the hybrid CNN-LSTM method can also better predict the cultural information characteristics of sculpture and painting. The numerical values of cultural characteristics of paintings mostly start from 0.6. Most values range between 0.6 and 0.9. It can also be seen from Figure 8 that there are large fluctuations for different moments. However, the hybrid CNN-LSTM not only better predicts the changing trend of sculpture and painting, but also better predicts the size of the sculpture data value. The CNN-LSTM method in predicting the cultural information characteristics of sculpture and painting shows that it can better guide people to understand the interoperability of sculpture and painting. Figure 9 shows the distribution of predicted and actual values of line features for sculptures and paintings. The blue curve represents the predicted value of the line feature, and the red curve represents the actual value of the line feature.

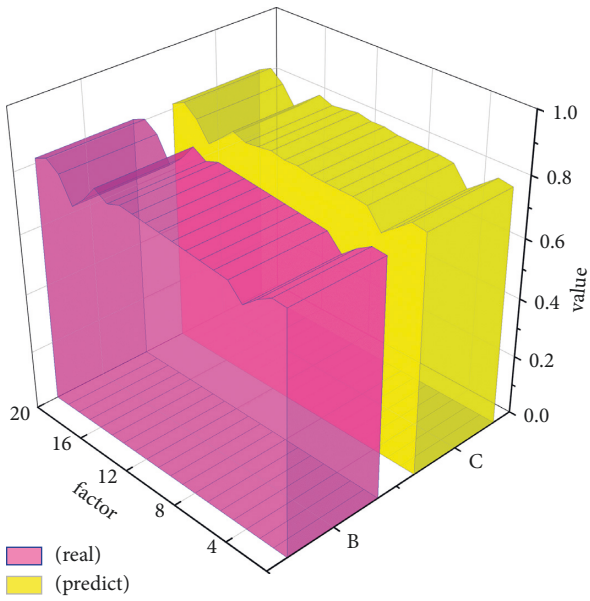

Figure 8: Prediction and actual value of cultural characteristics of sculpture and painting.

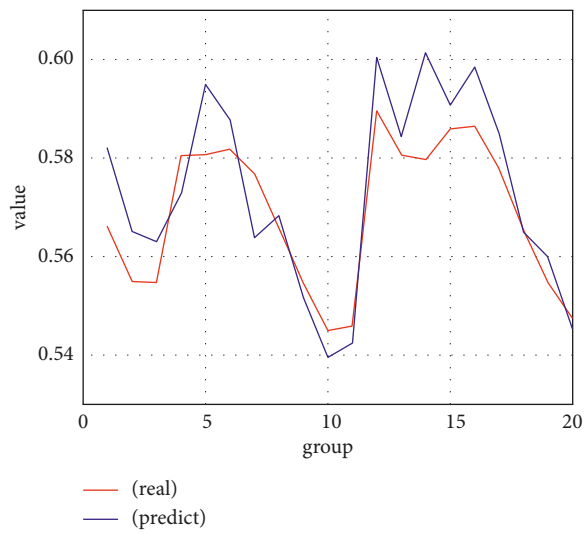

Figure 9: Predictive curve trend of line characteristics of sculpture and painting.

The abscissa represents the data between different groups. In this study, 20 sets of data were selected as the test set. In general, the change trend and numerical value of the predicted value of the line feature are in good agreement with the actual line feature value. Although there are relatively large peaks and troughs in the line characteristics of sculpture and painting, there are also large fluctuations. However, the hybrid CNN-LSTM method can better predict the changing trend of the line features of sculpture and painting.

5. Conclusions

There is a certain degree of interoperability between Chinese traditional sculpture and painting. The drawing of traditional sculpture generally starts from the art of painting. Therefore, understanding the basic artistic characteristics of painting is also crucial to the design of sculpture. However, traditional artificial methods rely only on experience or professional knowledge to understand the interoperability between sculpture and painting in terms of patterns, colors, and other characteristics. The cultural information characteristic of sculpture and painting is also a key factor for Chinese culture. Big data technology can better handle the characteristic data of patterns, colors, lines, and cultural information of sculptures and paintings.

In this study, a novel CNN-LSTM hybrid algorithm is designed using the CNN and LSTM methods of big data technology to study the interoperability of Chinese sculpture and painting. It will conduct related research from four aspects: patterns, colors, lines, and cultural information characteristics of sculpture and painting. Overall, the hybrid CNN-LSTM method can better extract the spatial and temporal features of the four aspects of sculpture and painting. It can also better predict the data values of the four characteristics of sculpture and painting. This can better guide people to discover the interoperability between Chinese sculpture and painting. From the perspective of prediction error, the largest prediction error is only 3.03%, and this part of the error comes from the prediction of cultural information characteristics of sculpture and painting. For the prediction of the pattern information of the sculpture, most of the prediction errors are within 3%, and only a few errors exceed 3%. This shows that the hybrid CNN-LSTM algorithm has high accuracy in predicting the features of sculptures and paintings. This is helpful for understanding the interoperability between sculpture and painting.

Data Availability

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

Conflicts of Interest

The author declares no conflicts of interest.

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