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Retraction

Retracted: Intelligent Computer Technology-Driven Mural Pattern Recognition Method

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] W. Wei and L. Gao, "Intelligent Computer Technology-Driven Mural Pattern Recognition Method," *Advances in Multimedia*, vol. 2022, Article ID 6148192, 7 pages, 2022.

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Research Article

Intelligent Computer Technology-Driven Mural Pattern Recognition Method

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As an important part of cultural heritage, murals reflect the economy, culture, and ideas of different historical periods and are an important basis for historical research. The lines in murals are the core elements to express the beauty of images. They have an irreplaceable special position in murals and are of great significance in the protection and restoration of murals. With the development of image recognition technology, the recognition of mural images has become a key research topic. In recent years, as a new image processing technology, deep learning based on a convolutional neural network is widely used in many fields. Using a convolutional neural network to recognize images has become a very active topic. With the continuous deepening of the number of layers of the convolutional neural network model, its autonomous learning ability of image recognition continues to improve. However, there are still some problems in the current image recognition model based on a convolutional neural network for mural images with rich structural details and complex texture and color. Therefore, according to the texture and structural characteristics of mural images, this paper uses the design idea of a convolutional neural network for reference to carry out research on mural image recognition. The improved algorithm proposed in this paper is tested on the experimental data set of mural images. The experimental results show that the improved algorithm can reduce the recognition error; enhance the edge, texture, and structure information of the reconstructed mural image; and enrich the detail information of the reconstructed mural image.

1. Introduction

As an art form with a long history, murals contain profound cultural connotations, highlight ancient thoughts and brilliant artistic civilization, have very important artistic value, and play a positive role in improving China's cultural soft power and expanding the international influence of culture. The walls, tops, and niches of many caves in Mogao Grottoes are full of exquisite rock color murals, which vividly show the historical features, myths, and legends of various times, as well as people's life scenes at that time. The murals in Mogao Grottoes are rich in color, simple and thick lines, and complex and changeable in structure and texture [1]. On the basis of integrating the artistic elements of various regions and highlighting the local culture and artistic characteristics, they are of great research value. Due to the influence of external factors such as environmental changes and human activities, many precious murals in these Grottoes have experienced serious qualitative changes for hundreds of thousands of years. It is urgent to protect murals. The main goal of the protection of ancient murals is to protect and repair them so that human beings can see more vivid historical relics. However, the traditional restoration of murals mainly depends on manual implementation. This way of mural protection is inefficient, which has seriously restricted the development of mural protection in China. In recent years, the combination of information digitization technology and architectural art protection has become a development trend [2]. Through computers,

big data, networks, etc., it can provide technical support for mural restoration and display. The types of murals are shown in Figure 1.

In view of the severe challenges faced by mural recognition, China has carried out a series of fruitful works on mural restoration. By building a Dunhuang mural database and using digital technology for mathematical modeling, the cultural relics protectors realized the interactive design of virtual and reality. It took four years to establish the digital exhibition center with digital Dunhuang as the core [3]. Combined with the protection and utilization facilities project, the three-dimensional virtual reconstruction technology is explored, and the virtual three-dimensional rendering model is generated based on the spatial information model, so as to guide the regeneration of mural images. In the early stage, the lesion location of murals is detected by mural digitization technology, and then, the specific restoration work is implemented in the later stage, which greatly improves the protection and restoration work, and is an important auxiliary tool in mural protection research work. However, in the field of superresolution reconstruction and display of cave mural images, there is still much work to be carried out. Since the 20th century, there has been a wave of breaking away from tradition in the field of literature and art [4]. Primitive art, indigenous art, and Oriental art have all inspired modern artists. The creative concept of murals has also changed, from the original architectural attachment to an organic component. The general trend of mural design is to achieve harmony of the overall space environment with a small number of colors and simple compositions. Today, when public art is so prosperous, this craft has not declined but has begun new prosperity. When you walk on the street, you can always inadvertently find the decorative wall or ground. It is not only decorative but also brings some interest to people in the tense and busy work. The form of inlay technology has gone beyond the existing materials, and the language is also richer. Due to its strong flexibility, the scope of application is more and more extensive, and this material has a strong flavor of the times. The application of optical illusion in painting, whether in the development of art or science, has many theoretical works, which have a solid theoretical foundation for academic research. Murals, as one of the earliest painting forms, use the form of illusion in mural creation [5]. There is not much theoretical basis in the academic circles, and there is a relative lack of attention. Grasp this blank area, as a research entry point, combine a large number of optical illusion theoretical basis with the theoretical guidance of mural creation, which is relatively few in domestic research topics.

Mural art is a special language symbol system, which has its own way of representation different from other language systems. If you do not understand the symbolic system of art, you are unlikely to understand it at all. Modern mural art expands into two forms in the traditional way of expression: first, it is closely combined with the environment, and even the mural design is extended in the sense of architectural function or spatial environment; the second is the rich changes caused by the diversity of materials and techniques [6]. Of course, this diversity is caused by the changes in modern architectural functions and spatial environment. Therefore, from the above discussion, we can see that the language of murals covers a variety of forms of expression. This paper begins by analyzing that murals can be classified from many perspectives, such as function, means of expression, and available public space. Therefore, the mural should be understood in a broad sense, not limited to the traditional sense of a narrow form with strong technicality. Thus, here, we reiterate its meaning to set the stage for the following discussion. An intelligent computer technology-based approach to drive mural pattern recognition is proposed. The results show that public murals are different from the mainstream because they are the product of individualization, expressing personal emotions and embodying the spirit of artistic creation, and do not exist in public spaces, much less have a public function.

2. Related Work

2.1. The Concept and Research Status of Murals. In fact, modern murals have evolved into wall art, in which the painting forms of two-dimensional space and three-dimensional space, as well as the three-dimensional and semi-three-dimensional production forms, have been accepted by the architectural interface, and a variety of materials and processes have also been applied to mural creation. Various meanings indicate the fuzziness or marginality of the concept of murals [7]. Although some art forms do not have the typical characteristics of murals, they have some formal or functional characteristics of murals. The concept of contemporary public art reflects the spirit of the times, which is actually making art life. Compared with traditional murals, contemporary mural art is called contemporary public art because it gives consideration to application, has a dependency on the environment, takes contemporary public consciousness as the basis, takes social overall consciousness as the value attribute, is more positive and pleasant, and even pursues aestheticism and avoids extremes and diversification of techniques.

The meaning and concept of contemporary murals are very broad, which is caused by the changes in human aesthetics and emotion, as well as the changes in the architectural environment itself [8]. Under the unique social situation in China, mural art should be public, which is the most public art with the characteristics of the times and Chinese style, and fully embodies the ideals of the times. This is the public art advocated. For today's open and changing society full of confidence and hope in China, it can adapt to the pulse of the times and fully reflect the people-oriented spirit facing the future. The diversified expression mentioned here is mainly based on the illusion mentioned in this article, which covers not only vision but also smell and touch. Among the emerging artistic expression techniques, multimedia, sound, light and electricity, and various materials emerge in endlessly, which cannot be limited to painting expression, and have special significance for the development of murals [9]. In fact, mural art is to achieve a sense of motion and flicker of visual perception through painting, so that the optical nerve can produce dizzy light

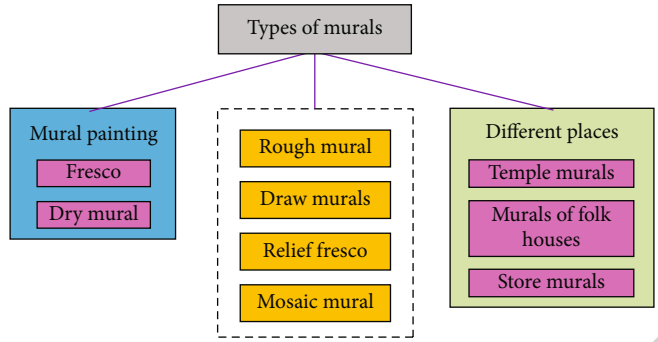

Figure 1: The types of murals.

effects and visual illusions in the process of contact with the picture graphics. Mural artists use this to explore the relationship between visual art and perceptual psychology, trying to prove that rigorous scientific design can also activate the visual nerve, and arouse and combine visual images through visual effects, so as to achieve the same moving artistic experience as traditional painting. At that time, this art was applied to the field of home murals and was widely used in wall decoration. We can imagine how colorful and rich this kind of home life should be. While providing people with more choices of wall decoration materials, it adds infinite artistic charm to our home life and shows the fashionable characteristics of wall decoration that is both personalized and not extravagant. The geometric shape is one of the essential design elements in home decoration, but few people can apply geometric shapes so wonderful and illusory and can express such tension and a strong sense of rhythm [10]. In the process of style design, we abandoned the expression of traditional wallpaper but used geometric patterns that can make the color contrast stronger, in pure color or geometric form. It impacts people's visual senses with strong stimulation, causing the visual illusion of spatial deformation so that it has a sense of fluctuation and change. The artistic value of murals stems from their application function, which is different from the pure painting form. This kind of functional value comes from the beginning of murals, and the functionality of murals also comes from the functional role of architecture and environment. The so-called function refers to the use function. Architectural space itself is practical. Different buildings have different functions. The visual and psychological effects formed by different functions give people different impressions.

Murals participate in the creation of this function and closely around the function of space to play the function of murals. The functional expression of mural art cannot be separated from the specific space environment. The visual image established by murals in a specific space may lose its aesthetic value when transferred to another space, and the functional characteristics are naturally out of the question [11]. Therefore, the function of murals cannot be separated from the carrier and architectural space environment. The main functions of murals in public space are decoration and beautification, commemoration, publicity, enlightenment and education, strengthening, and adjustment. Decoration and beautification function, as the name suggests. The basic motivation of mural setting in public space is to play a beautifying function, and all other functions also achieve the effect on the basis of beautifying function. Harmonious public environment and create a special atmosphere. Integrate the public environment and the picture harmoniously to form a new visual space. To strengthen the function, this kind of mural is usually set outdoors [12]. Through the mural content, theme, and form of expression, it vividly reminds the skills and attributes of specific places, plays a role in identification and induction, and has a finishing touch. These include murals with geographical features, which imply the characteristics of the location of the building by directly describing the local places of interest, folk customs, local customs, or the natural scenery of the location of the building.

To strengthen the function, this kind of mural is usually set outdoors. Through the mural content, theme, and form of expression, it vividly reminds the skills and attributes of specific places, plays a role in identification and induction, and has a finishing touch. These include murals with geographical features, which imply the characteristics of the location of the building by directly describing the local places of interest, folk customs, local customs, or the natural scenery of the location of the building [13]. The types of murals can be divided into narrative, symbolic, romantic, and decorative. In terms of materials, they can be divided into drawing, soft materials, and hard materials. From the two-dimensional and three-dimensional shapes, it can be divided into plane type, relief type, high relief type, plane three-dimensional combination type, and suspension type. In terms of image expression, it is divided into concrete type, image type, and an abstract type. From the concept, it is divided into visual modeling and concept expression [14]. Murals have a diversity of types and forms. The diversity modern architectural functions have led to the diversity of mural types and forms. The rich and diverse forms meet the needs of the architectural space environment and make the mural art and architecture form a more reasonable and closely coordinated relationship.

2.2. Current Status of Functional Research on Murals. The function of a mural requires that its appearance must meet the functions and requirements of the public space, which indirectly determines the form of mural expression. Whether it is the theme first, or the use of the means of

expression to choose painting or materials, is restricted by the specific functionality of the mural. Therefore, the function of murals determines their form of expression to a certain extent. In the art of design, functionality and formality should be organically unified. Functional beauty is the premise and foundation of formal beauty, which in turn can enhance functional beauty [15]. Formal beauty is a form of expression, which has a specific meaning, which mainly refers to the combination of art language and law and purpose, that is, the law of compound beauty and the external formal structure of works with compound aesthetic needs and purposes. Obviously, form and function are essentially different and inseparable; That is, there is no form without function, and there is no function without form. The form is the existence of the function. Therefore, functional beauty and formal beauty promote each other and are inseparable. They constitute the most basic principles and characteristics of the design.

Murals are closely attached to the existence of buildings and public spaces. If they meet the many requirements of its space application and reflect the functional beauty and formal beauty, they can correctly affect the thinking and lifestyle of people who appreciate murals and have a positive and positive impact. Therefore, for the application of illusory forms of expression in murals, we should first focus on the requirements of the overall space and public environment for the creation itself. The premise of the mural's existence and creation must be people-oriented [16]. As a mural artist, he must know and care about people when creating murals in public spaces. The content embodied in the works and the atmosphere created in the environmental space are works that meet the needs of humanization and reflect humanistic care. Mural works should be more different from easel paintings to reflect their public performance and meet the needs of the public. With the continuous development of social urbanization, people's spiritual and cultural requirements continue to improve. Gradually, murals appear in people's daily life, and more small murals emerge in endlessly. The commerciality of murals naturally shows that many murals created for certain commercial purposes are more like public service advertisements, which also achieve commercial purposes without clear investor information [17]. In a commercial society, it is an indisputable fact that the commerciality of murals is gradually revealed, and it is inevitable. In a commercial society, the commerciality of mural creation is inevitable. In high-speed cities, how to use means to achieve artistic effects, mural as a public art also builds a bridge between mural and commerce. The development of murals is bound to be commercialized. The commercialization of murals is a special performance given a task at the beginning of creation. The theme first is enjoyed not only in the large-scale historical themes of traditional murals but also in many small murals. The concrete embodiment is the real phenomenon that murals are becoming more and more commercial. The illusion expression form in the mural reflects the beauty of mathematics to a certain extent because its unique presentation makes people leave a deep impression. The creative process of presenting everything is one of the artistic manifestations of this kind of mural [18]. At the beginning of creation, the artist pays the most attention to the artistry of such murals. Although the levels of aesthetic groups in public spaces are uneven, the relative aesthetic level is also uneven. How to create artistic works with the theme of expressing tasks in such a real space, which can enable most viewers to obtain information, is the embodiment of its artistic function. The appreciation of artistic expression by the audience is a unique enjoyment. The images and details that the psychological aesthetic needs yearn for and pay attention to are the creative ideas of artists when creating such murals.

For this illusion form of expression to be artistic in creation, it requires artists to have a high degree of artistic cultivation and aesthetic interest [19]. Here, graffiti art is mentioned again. The origin and use of graffiti art determine its weak artistry. Staying away from the simplicity and symbolism of graffiti culture and constantly approaching artistry is one of the difficulties that should be paid attention to in the field of murals in the future. The entertainment of the illusion expression form of murals is far greater than other forms of expression [20]. The reason for this is because of the form of illusion. In the era of information dissemination, the requirements for entertainment are higher and higher. Entertaining designs are always popular and impressive. Things without entertainment tend to be boring and boring, and the viewer has no God's surprise and sigh.

3. Design of Application Model

3.1. Structure of the CNN. Compared with general natural scenery or texture images, mural images not only have rich structural information but also usually contain a large number of complex texture information and repetitive patterns in the picture. They have the artistic style of various periods in structural layout, character modeling, and line drawing and have complex and changeable characteristics. However, the current image superresolution reconstruction model based on a convolutional neural network needs to solve the following problems in the classification of mural images. When extracting features from natural images, convolution kernels of the same size are used in each layer. The context information outside the local area cannot be used for feature extraction with a single scale. For mural images with different scales of structural and texture features, the single scale of feature extraction is not enough to completely restore the medium and high-frequency feature information of mural images. Some methods deal with the features of low-frequency channels equally in classification, ignoring the interdependence between feature channels to a certain extent, which weakens the ability of the network to approach the feature details of mural images.

When the network depth is continuously increased, the network parameter quantity is a problem. The increase of the parameter quantity will increase the computational complexity, produce the gradient dispersion explosion problem, and have a certain impact on the convergence of the network. According to the actual needs for superresolution reconstruction of mural images, a depth convolution neural network model suitable for the composition

characteristics of mural images is built, and its classification is realized. The algorithm uses multiscale feature extraction blocks in the feature extraction stage. By using convolution kernels of different scales, different boundary filling values are set. At the same time, different scales of feature extraction are carried out on the input low-resolution mural images, and then, the output feature maps of the same size are fused. The basic structure of the convolutional neural network is shown in Figure 2.

In order to better fit the characteristic distribution state of the original data, it is necessary to add a nonlinear activation function after convolution. In the convolution process, each pixel value of the input image is given a corresponding weight, which is actually a simple linear operation. The submatrix corresponds to the convolution summation process of the position of the input characteristic graph, which is expressed as follows:

$$a^L = f\left(z^L\right) = f\left(a^{L-1} * w^L + b^L\right). \tag{1}$$

After pooling, the CNN model performs a convolution activation pooling operation on the input feature map in turn and finally outputs a predicted value at the end layer and makes losses with the corresponding initial tag data. Define the loss between the predicted value and the real value, and its mathematical expression is as follows.

$$J(w,b) = \frac{1}{2} f\left(w^L a^{L-1} + b^L - y\right)_2^2. \tag{2}$$

The gradient of the output layer is solved above, and the inactive output gradient is obtained by layer by layer recursion below, which can be expressed as

$$\delta^l = \frac{\partial J(w,b)}{\partial z^l} = \left(\frac{\partial z^L}{\partial z^{L-1}} \cdot \frac{\partial z^{L-1}}{\partial z^{L-2}} \cdots \frac{\partial z^{l+1}}{\partial z^l}\right)^T \frac{\partial J(w,b)}{\partial z^L}. \tag{3}$$

Among them, the learning rate plays an important role in the process of gradient backpropagation, which directly affects the convergence performance of the network. This paper will set the learning rate in the gradient descent algorithm according to the exponential decay method. In order to better restore the texture and line drawing details of the mural image, the pooling layer is removed in the process of building the model, and the full convolution network model is used to prevent the convolution neural network from losing the mural details in the process of forwarding feature extraction. In view of the fact that the correlation between RGB three channels is not considered in the super-resolution reconstruction of color mural images by real value convolution operation, it will lead to the loss of color and structure information.

3.2. Algorithm Design and Network. Because the structure and texture features of mural images have different scales, it requires different scales of feature extraction for mural images. In the feature extraction stage, four convolution kernels with different scales are used to extract the feature information of the target mural image directly. Then, the extracted multiscale information is merged and reorganized to form a new feature map. This process can be expressed as

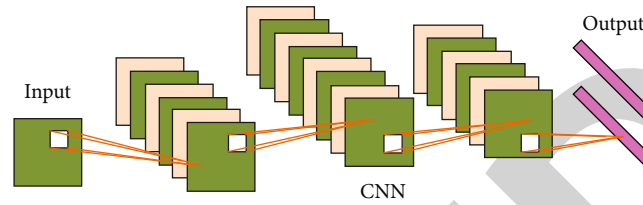

Figure 2: The basic structure of the convolutional neural network.

$$F_1 = \sum_{i=1}^{n} \Phi\left(W_{1i} * I^{LR} + B_{1i}\right), \tag{4}$$

$$F_2 = f\left(W_{2i} * F_1 + B_{2i}\right). \tag{5}$$

Because simple stacking residual attention blocks cannot improve the reconstruction performance of the network, this paper introduces long jump connections to stabilize the training of the very deep network:

$$F_g = H_g\left(F_{g-1}\right) = H_g\left(H_{g-1}\left(\cdots H_1(F_2)\cdots\right)\right), \tag{6}$$

$$F_{DF} = F_2 + W_{LSC} H_g\left(H_{g-1}\left(\cdots H_1(F_2)\right)\right). \tag{7}$$

The feature maps are aggregated into feature maps and used as feature descriptors. After the global average pooling operation, the spatial information of the global receptive field of each feature map is placed into the feature map. Input the deep mapped feature map of the attention block through the residual channel to the sub-pixel convolution layer for reconstruction, and the reconstruction process is shown in the following formula:

$$H^{\mathrm{REC}} = PS(W_3 * F_{DF} + B_3). \tag{8}$$

The training objective is to minimize the mean square loss function, that is, to minimize the sum of the absolute differences between the original high-resolution mural image and the reconstructed mural image after net output through the network. The schematic diagram of the channel attention mechanism is shown in Figure 3.

In this paper, without increasing the feature dimension, the nonlinear correlation between feature channels is modeled, and the fusion between feature channels is carried out, so as to enhance the deep expression ability of the network. The global average pooling method is used to convert the global spatial information of the channel mode into the channel descriptor.

4. Experiments and Results

According to the categories of Buddhist murals, this paper collects an appropriate amount of representative mural images to form a high-resolution mural image set. Among them, about 150 pieces are collected for each type, and the

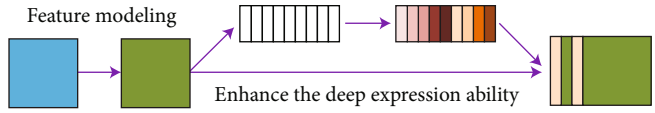

Figure 3: The schematic diagram of the channel attention mechanism.

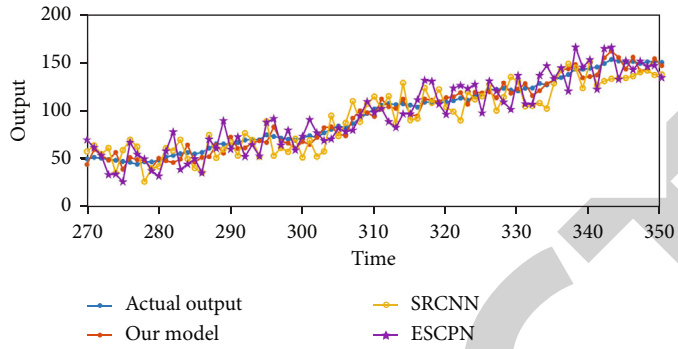

Figure 4: The feature degree of mural recognition by different algorithms.

image size is 300 × 300. The training set consists of 60 pieces randomly selected from each type of data set, a total of 180 pieces, and the test set consists of 15 pieces randomly selected. In order to obtain more data samples and improve the accuracy of hyperfractional reconstruction of the network, the training image is rotated and scaled. On the basis of rotating 90, 180, and 270 degrees, respectively, it is scaled according to the coefficient of 0.9, 0.8, 0.7, and 0.6, and a total of 2160 training images are generated. Then, the 2160 mural images are downsampled to obtain a low-resolution image set.

In order to verify the subjective visual effect of this algorithm on mural image reconstruction, this paper uses the trained network model to magnify the low-resolution mural images in the training set to verify the effectiveness of this algorithm. However, due to the shallow number of network layers, there is a problem of insufficient feature extraction for mural images with complex structure and texture, so there is some room for improvement. This paper also adds multi-scale feature extraction blocks and channel attention mechanisms to enhance the feature extraction of the network. The feature degree of mural recognition by different algorithms is shown in Figure 4.

The network uses the global residual structure to connect the input directly to the output, which accelerates the training process of the network, so the number of iterations used to achieve convergence is less, but compared with the network in this paper, which does not consider the correlation between different output characteristic channels, the convergence value is reduced. When adding 5 and 7 residual channel attention blocks, the number of network layers is relatively shallow compared with the above two networks, and its reconstruction performance will be greatly reduced, and the speed of network convergence is also slow. The classification results of the mural image test set under different methods are shown in Table 1 and Figure 5.

Table 1: The classification results of the mural image test set.

Dataset	Scale	Bicubic	SRCNN	ESCPN	VDSR	Ours
Buddha mural	2	81.57	83.96	82.21	84.87	85.71
	3	80.37	81.65	83.67	85.66	87.45
	4	77.42	79.42	80.11	87.14	89.91

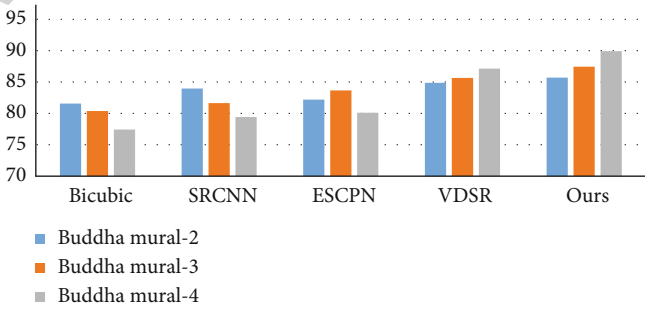

Figure 5: The classification results of the mural image test set.

In order to further illustrate the impact of adding a channel attention mechanism to the local residual block on the performance of network reconstruction, this paper selects a 3-fold magnified caisson mural image and compares the reconstruction results between the multi-scale residual network with the channel attention mechanism and the standard residual network.

5. Conclusion

The evaluation principle of the form of expression of illusory art in mural art is first reflected in that it must have the basic functional nature of mural art, and then, it must contain the basic attributes of the creation of this form of expression.

The ultimate development goal of this form of expression is to take the basic point as the evaluation principle and maximize the embodiment of humanistic care and public functions on this basis. Based on this, based on the traditional image classification algorithm based on a convolutional neural network, according to the composition characteristics of mural images, this paper proposes an improved algorithm for mural image classification. In the process of deep residual mapping, a channel attention mechanism is introduced to model the correlation between different feature mapping channels, and it is embedded into local residual units to form the residual channel attention structure, which is used to enhance the ability of the network feature expression through cascading. The experimental results show that the improved algorithm can reduce the recognition error; enhance the edge, texture, and structure information of the reconstructed mural image; and enrich the detail information of the reconstructed mural image.

Based on the existing work, this method can be further improved in the following aspects. Later, we hope to introduce the use of quaternion convolution kernel in the process of color mural reconstruction and use quaternion operation to directly process the three-dimensional color vector, so as to ensure the representation of color mural images under the guidance of quaternion operation. Then, define the quaternion convolution operation and the quaternion convolution neural network learning algorithm, which can directly process the three channels of the color mural image. In the future, we plan to develop a mural pattern recognition method using virtual reality driven technology.

Data Availability

The datasets used during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

The author declares that he has no conflict of interest.

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