Digital Art Creation and Optimization of Intangible Cultural Heritage Based on Image Processing Algorithm

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Abstract. As a new art form, digital art provides new ideas and ways for the inheritance and growth of (ICH) culture with its diversified expressions and efficient communication efficiency. In this study, wavelet neural network (WNN) algorithm will be used for image processing. Through feature detection, noise reduction and enhancement of ICH images, clearer and more vivid digital works of art will be obtained. By combining computer aided design (CAD) with traditional handicrafts, it is expected to provide new creative for ICH digital art creation. To verify the rationality and superiority of the image processing algorithm adopted in this article in ICH digital art creation, a computer simulation experiment was conducted. Using WNN's image classification algorithm, the classification accuracy of ICH images of folk dance, traditional handicrafts and folk activities all exceeds 90%, which proves that the algorithm has excellent classification ability and generalization performance, and can be effectively applied to ICH image classification and recognition tasks.

Keywords: Image Processing Algorithm; Intangible Cultural Heritage; Computer Aided Design; Digital Art
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1 INTRODUCTION

ICH is a precious heritage of mankind and an important embodiment of a country's profound historical background and cultural heritage. ICH not only carries the cultural tradition and history of a nation or region, but also is an important pillar of people's cultural identity and national spirit. Some cultural heritage digital experiences are mostly presented in simple images, text, or videos, lacking interactivity and immersion. There are few interactive ways between users and cultural heritage. Data cannot be shared between different devices, resulting in inconsistent user experience. Belhi et al. [1] obtained data on users' behavior and interest in cultural heritage digital experiences through multi-channel and multi-dimensional data collection. Perform cleaning, deduplication, labeling, and other operations on the collected data to facilitate the application. Based on the preprocessed data, train a model that can optimize the digital experience of cultural heritage. Apply the trained model to practical scenarios to continuously improve user experience and engagement. However, with the rapid advancement of modernization and the impact of globalization, ICH is facing unprecedented challenges and crises. Therefore, how to protect and inherit ICH has become an urgent problem. As a new art form, digital art provides new ideas and ways for the inheritance and growth of ICH culture with its diversified expressions and efficient communication efficiency. Butnariu [2] aims to explore the cultural connotations and artistic value behind the noise generated by the Dachian dragon, providing a new theoretical perspective and practical methods. By exploring the engineering electronic heritage, we aim to provide technological support and creative inspiration for the inheritance. By analyzing the noise generated by the Dachian dragon as a case study, we aim to explore its unique cultural connotations and artistic expressions. Secondly, statistical analysis methods are used to organize and analyze the collected noise data, and the main characteristics and influencing factors of Dachian dragon noise are summarized. Finally, through literature research, understand the current application status and development trends of engineering electronic heritage. Digital art can create a broader space and possibility for the spread and growth of ICH culture by digitally collecting, presenting and storing ICH images. Intangible cultural heritage has unique cultural value and inheritance significance, so visual analysis in urban space has important practical significance. Visual analysis of urban space helps to enhance the visibility and identity of intangible cultural heritage. In today's society, many intangible cultural heritage projects are gradually being ignored and even facing the risk of loss. By utilizing digital technologies such as virtual reality and augmented reality, some intangible cultural heritage projects that have disappeared or are in danger can be vividly reproduced. These digital technologies can provide immersive experiences, allowing the public to have a deeper understanding of the history and cultural connotations of intangible cultural heritage. Dang et al. [3] Through visual analysis of intangible cultural heritage in urban space. Hotspot maps can display the degree of aggregation of regions, while time series maps can reflect the changes of a certain over time. In addition, the spatial distribution map can also show the distribution in different cities, which helps the government and relevant institutions to formulate targeted protection measures. ICH digital artistic creation refers to the use of computer technology and digital image processing algorithm to create digital artistic works with traditional artistic characteristics. This creative way can not only retain the charm of traditional art, but also realize the artist's innovation and personalization.

At present, existing research mainly focuses on the non-destructive analysis of surface coatings and pigments on cultural relics using spectral technology, but there are still shortcomings in the overall structure and material analysis of cultural relics. Demenchuk et al. [4] selected different types of cultural relics samples, including ceramics, bronze, and stone tools, and conducted measurements and analysis using various spectral instruments and equipment. While using a Raman spectrometer to study the molecular structure and material of cultural relics. In addition, we also conducted in-depth research on the surface coating of cultural relics using an infrared spectrometer. In terms of data analysis, we used pattern recognition and chemometrics methods to process and analyze spectral data. Through the above research, it was found that there are significant differences in the surface element composition and molecular structure of different types of cultural relics samples. In addition, we have also discovered the chemical properties and microstructure of some surface coating materials, which is of great significance for a deeper understanding of the production process and protection plans of cultural relics. In digital art creation, image processing algorithm is one of the most critical technologies. Through the digital processing and processing of ICH images, digital works of art can show the characteristics and connotation of ICH culture more vividly. Doulamis et al. [5] collected some Twitter images and conducted experiments. The experimental show that our method can successfully extract feature information and generate more accurate 3D models. However, at the same time, we have also identified some challenges and issues, such as data quality issues and algorithm robustness issues, which require further research and improvement. In terms of sustainable development, this technology can provide more efficient and accurate means for cultural heritage protection, which is conducive to promoting innovation and development of cultural heritage protection work. WNN is an efficient image processing algorithm, which has the functions of multi-scale analysis, denoising and compression, and is suitable for denoising and enhancement of ICH images. Guo and Li [6] use video streaming technology to organically combine multiple images and animation elements, forming a smooth visual effect. These animation elements include fluid, flames, and smoke, which present excellent visual impact in the video and effectively attract the audience's attention. Through video streaming technology, designers have integrated advertising with social media platforms. Viewers can achieve real-time interaction with advertisements through touch screen or gesture control while watching them. This interactive approach brings a brand new viewing experience to the audience, while also improving the effectiveness of advertising. By utilizing video streaming technology, this advertisement can be played on various devices, including computers, phones, tablets, etc. This not only expands the scope of advertising dissemination, but also meets the viewing needs of different audiences. In this study, WNN algorithm will be used for image processing. Through feature detection, noise reduction and enhancement of ICH images, clearer and more vivid digital works of art will be obtained. By optimizing and improving the algorithm, the efficiency and stability of the algorithm are improved, which provides more reliable technical support for digital art creation. By combining CAD with traditional handicrafts, it is expected to provide new creative methods and ideas for ICH digital art creation. Moreover, I also hope to provide more abundant and diverse expressions and means for digital art creation.

The image is often affected by noise during transmission, which reduces the quality of the image. When evaluating the performance of cultural heritage image classification models, Janković [7] use indicators such as accuracy, recall, and F1 value. In addition, we can comprehensively through methods such as confusion matrix, ROC curve, and AUC value. By comparing the performance of different attribute selection methods, we can find that suitable attribute selection methods can significantly improve the performance of the model. This is mainly because appropriate attribute selection can reduce the interference of noise features and improve the generalization ability of the model. In addition, models implemented using deep learning mainly due to the powerful feature learning and abstraction capabilities of deep learning models. Jin and Yang [8] quickly generate 3D models of schemes through computer-aided design software. SketchUp software allows for easy adjustment of building parameters such as angle, height, and size, as well as scene roaming to observe the effects of design solutions from different angles. At this stage, the designer uses computer-aided design software to draw detailed construction drawings, such as using AutoCAD software to perform precise dimensions, text annotations, and other operations, making it easier for the construction party to understand and implement the design plan. The use of 3ds Max software can create realistic 3D scenes. Liu and Yang [9] quickly generate three-dimensional models of environmental art design schemes. SketchUp software allows for easy adjustment of building parameters such as angle, height, and size, as well as scene roaming to observe the effects of design solutions from different angles. At this stage, designers can draw detailed construction drawings through computer-aided design software, and use AutoCAD software to perform precise dimensions, text annotations, and other operations, making it easy for the construction party to understand and implement the design plan. At this stage, designers can use computer-aided design software to create the final rendering of environmental art design. For example, using 3ds Max software can create realistic 3D scenes, allowing customers to have a more intuitive understanding of the effects of design solutions. At this stage, designers can conduct virtual simulation experiments using computer-aided design software. In today's increasingly popular mobile devices, the user interaction experience of mobile systems has become increasingly important. In order to improve user experience, the application of context awareness and machine learning in mobile systems has gradually become a research hotspot. Liu [10] explored the art of designing refers to the ability of mobile systems to perceive and understand the user's context, such as location, emotions, activities, etc., in order to provide appropriate services for users. This type of service can include prompt information, navigation, music playback, etc., making the use of mobile systems more convenient and efficient. In the user interaction experience of mobile systems, context awareness can greatly improve the practicality and friendliness of the system. Machine learning is a technology that enables computer systems to learn from data. In the user interaction experience of mobile systems, machine learning can be used to identify users' operating habits, predict users' intentions, recommend relevant content, etc., thereby improving the user experience.

In this article, the image processing algorithm is applied to ICH digital art CAD design, and the efficiency and quality of digital art creation are improved by optimizing and improving the algorithm.

The main innovations of the research are as follows:

(1) This article applies the image processing algorithm to ICH digital art creation, which provides new ideas and methods for digital art creation and a new way for the inheritance and growth of ICH culture.

(2) By optimizing and improving the WNN algorithm, the efficiency and stability of the algorithm are improved, which provides more reliable technical support for digital art creation.

(3) The expression of ICH digital art improves the audience's experience and sense of participation, expands the expression and means of digital art, and promotes the progress and growth of digital art creation.

The chapters of the thesis are arranged as follows:

The first section introduces the importance of ICH culture and digital art; The second section summarizes the related concepts and development trends of ICH culture and digital art; The third section describes in detail the process and method of ICH digital art creation based on image processing algorithm, focusing on the application of WNN algorithm; The fourth section verifies the rationality and superiority of the algorithm through computer; The sixth section summarizes the main research results and conclusions of this article, emphasizes the importance and function of the research results to ICH culture and digital art, and looks forward to the future research direction.

2 OVERVIEW OF ICH CULTURE AND DIGITAL ART

Mironova et al. [11] can obtain information on various aspects of painting, such as pigment layers and surface states, by analyzing the surface roughness of brush strokes. This information can not only be used to identify the material and production techniques of the painting, but also to evaluate the protection status and preservation environment of the painting. To achieve this goal, digital image processing technology and computer vision technology can be used to digitize paintings. Firstly, use a high-resolution scanner to digitize the painting and obtain a digital image of the painting. Then, the surface roughness analysis algorithm is used to process the digital image and calculate the surface roughness of the brush strokes of the painting. In the calculation process, the grayscale co-occurrence matrix method can be used to preprocess digital images to eliminate the influence of image texture on surface roughness calculation. Subsequently, the surface roughness values of each pixel in the image are calculated using edge detection or filtering based methods. Finally, the obtained surface roughness data is visualized to generate a surface roughness graph for drawing strokes. By using emotional analysis techniques in cognitive computing, users can determine their positive or negative attitudes towards FICH, thereby better understanding their needs and feedback. By utilizing the topic modeling technology of cognitive computing, we can analyze topics and topics related to FICH on Twitter, and explore user focus and behavior patterns. The predictive model of cognitive computing can predict the propagation trend of FICH on Twitter, providing reference for formulating communication strategies. By using the influence evaluation method of cognitive computing, it is possible to identify FICH influencers with high influence on Twitter, providing support for cooperation. Morales et al. [12] analyzed the dissemination characteristics, patterns, and influencing factors. The results indicate that Twitter, as an important platform for global social media, provides vast space and opportunities for the dissemination of FICH. The application of cognitive computing technologies such as sentiment analysis, topic modeling, trend prediction, and impact assessment can improve the accuracy and efficiency of FICH's dissemination analysis on Twitter. The data management of a multimodal cultural heritage document automatic registration system involves multiple aspects, including data collection, data processing, and data storage. In terms of data collection, Pamart et al. [13] use high-precision photogrammetric equipment to obtain high-definition photos of cultural heritage literature. At the same time, the system also supports various image processing technologies, which can process and analyze photos to extract feature information of literature. In terms of data processing, the system adopts advanced. The interface of the system adopts a simple and clear design style, with white and gray as the main colors, giving users a fresh and pleasant feeling. The functional modules of the system are clearly visible, allowing users to quickly find the functions they need. The interaction process of the system has also been optimized to simplify the operation steps as much as possible and improve user operation efficiency. Users can complete the registration and search of cultural heritage literature with simple clicks and inputs.

The digitization of cultural heritage presents cultural heritage in innovative ways, thereby attracting more visitors. In the era of the Internet, digital technology has provided new channels for the dissemination of cultural heritage, enhancing the audience's sense of participation and experience. The technology can enhance the visibility of museums in central Serbia and attract more visitors to visit. Digitalization of cultural heritage number of visitors to museums in central Serbia. Radosavljevi and Ljubisavljevi [14] can increase the visibility of museums and attract more visitors by strengthening digital construction, improving publicity effectiveness, and providing better navigation services. Meanwhile, with the advancement of technology, the application of digital technology will provide more possibilities. Museums in central Serbia should actively embrace the digital wave and constantly innovate meet the needs of audiences. This will make greater contributions to the inheritance refers to the process of using 3D scanning technology to digitize intangible cultural heritage projects and generate 3D models and data. This technology can achieve precise recording and restoration of intangible cultural heritage projects, providing important digital resources for cultural inheritance, cultural and creative industries, and tourism development. Before conducting 3D scanning of intangible cultural heritage, it is necessary to select appropriate equipment, including 3D scanners, cameras, tripods, computers, etc. Skublewska et al. [15] selected suitable equipment to improve scanning quality and efficiency based on different scenarios. For some intangible cultural heritage handicrafts with complex structures, a scanning scheme with multiple angles and lighting conditions can be adopted to ensure the accuracy and completeness of the scanning data. Data collection is the core step of 3D scanning. During the collection process, it is necessary to carefully observe and measure the scanned object, select appropriate positions, angles, and lighting conditions for shooting. To ensure the accuracy and stability of scanned data to avoid data loss or distortion. When we talk about cultural heritage, we usually think of those ancient buildings, artworks, and traditional customs. However, with the advancement of technology, digital art has gradually penetrated into the field of cultural heritage, injecting new vitality into our cultural heritage. Digital art creation elements are also playing a role in shaping the image of destinations. Digital art refers to the use of digital technology as a tool for creation and expression, creating artistic digital products. In recent years, with the continuous development of technologies such as virtual reality and augmented reality, the application of digital art in the field of cultural heritage protection and dissemination has become increasingly widespread. Digital art can record and present cultural heritage through digital means, allowing more people to understand and appreciate the charm of cultural heritage. Digital art creative elements can create a unique brand image for the destination through unique visual effects and creative expression techniques. Szubert et al. [16] combine local traditional cultural elements with modern aesthetics fashion, enhancing the brand value of the destination. With the progress and development of technology, the importance of cultural heritage protection is receiving increasing attention from people. Cultural heritage not only represents the development process of human civilization, but also contains human wisdom and creativity. However, due to various factors, cultural heritage is facing serious threats. In order to more effectively protect and utilize cultural heritage, Wang et al. [17] introduced a new system. The use of deep learning technology enables the processing and analysis of a large amount of image data in a short period of time, providing fast and accurate survey results. This not only reduces the burden on staff, but also improves work efficiency. This system is innovative in the field of cultural heritage protection, combining deep learning technology with cultural heritage protection, improving the automation and accuracy of cultural heritage protection work.

With the continuous development of technology, the protection and reconstruction of traditional village landscape has become a hot field of academic research and practical application. Among them, image recognition algorithms are important in landscape reconstruction. Wang et al. [18] explored how to use image recognition algorithms for traditional village landscape reconstruction, and analyzed their advantages, limitations, and applicability. The traditional village landscape, as a precious heritage of human history and culture, has unique historical, cultural, and artistic value. However, with the passage of time and the influence of natural and human factors, many village landscapes face the risk of damage or even disappearance. Therefore, using image recognition algorithms for landscape reconstruction is an important task, which helps to save and inherit this precious cultural heritage. The traditional printing is a national handicraft with unique charm and a long history. Its exquisite craftsmanship and rich cultural connotations have attracted widespread attention. However, with the acceleration of modernization and changes in market demand, the inheritance and development of this traditional craft face severe challenges. In order to protect and promote this precious national cultural heritage, Xiao [19] explored a software framework optimization design method. Pattern mining is a method of extracting, with the main purpose of discovering hidden patterns and patterns in the data. In traditional printing and dyeing processes in Xiangxi, pattern mining can help us extract exquisite techniques, unique styles, and other patterns from rich image and process data. To achieve this goal, we have adopted advanced pattern mining tools such as neural networks and support vector machines to establish an efficient pattern mining system. Image design and generation are one of the core elements. Zhang and Romainoor [20] explored how to generate pop art style images and their applications in cultural and creative products. Artificial intelligence is a technology that simulates human and so on. The application of these technologies in the cultural and creative industry enables designers to create images more efficiently, while also providing more possibilities for innovation in cultural and creative products. By utilizing convolutional neural networks (CNN) for feature extraction, the image is transformed into a series of numerical values. Reuse Generative Adversarial Network (GAN) to generate new images with similar features. Finally, the generated images are optimized through post-processing techniques to enhance their artistic value.

Computer graphics and image assisted design have gradually become important tools in art design teaching. Zhang and Rui [21] explored the application background and significance assisted design in art design teaching. And analyze its specific application and combination methods in art design teaching, and finally summarize its importance and application prospects. Computer graphics has changed the traditional teaching philosophy of art design, shifting the focus from hand drawn design to computer design. Students can design through computer graphics software to better grasp the accuracy and efficiency of the design. Computer graphics has led to changes in the teaching methods of art design. Teachers can use multimedia demonstrations, example teaching, and other methods to help students more intuitively understand design concepts and techniques, and improve teaching effectiveness. The rapid development of digital technology has provided new opportunities for the inheritance and development of Suzhou embroidery. Through the application of digital technology, Zhang et al. [22] conducted high-precision image acquisition and storage of Suzhou embroidery works, providing rich basic resources for subsequent data analysis. Meanwhile, with the help of artificial intelligence and big data technology, we can conduct in-depth data mining and analysis on Suzhou embroidery works, understand consumer preferences and needs, and provide strong support for innovative design of Suzhou embroidery. Digital technology not only contributes to the creation and production of Suzhou embroidery. In terms of sustainable production, efficient production of Suzhou embroidery can be achieved through technologies such as digital design and 3D printing, reducing production costs, increasing output, and meeting the needs of more consumers. In terms of sustainable consumption, digital technology can help consumers understand the production process and environmental attributes of Suzhou embroidery, increase their awareness and interest in Suzhou embroidery, and thus promote its market promotion and dissemination. Zhao [23] can more intuitively display cultural heritage information and improve the display effect by converting data into graphics or images. Viewers can learn about data information through interactive means and independently control the display content and methods to improve their viewing experience. Interactive data visualization technology can visualize and present information, helping viewers understand and analyze the inherent laws and connections of cultural heritage data. The application of interactive data visualization technology in the display of cultural digital heritage has gradually become popular. The 360-degree panoramic technology showcases the scenery and architecture of various corners of the Forbidden City, allowing viewers to freely browse and understand its history and culture. At the same time, technologies are also provided in the digital Forbidden City community, allowing viewers details and stories behind cultural relics. The application of these interactive data visualization technologies not only improves the visitor experience, but also makes cultural heritage more vividly presented to the audience.

3 APPLICATION OF IMAGE PROCESSING ALGORITHM IN ICH DIGITAL ART CAD DESIGN

Digital art can digitally collect, present and store ICH cultural information, and preserve ICH culture in digital form, which solves the problem that traditional protection methods cannot be preserved for a long time or cannot be preserved completely. Moreover, digital art can also integrate ICH culture into contemporary society through innovative forms of expression and communication, expand the influence and audience of ICH culture, and give ICH culture new vitality. The combination of digital art and ICH culture can not only promote the inheritance and growth of ICH culture, but also provide a broader expression space and creative inspiration for digital art creation. Digital art has gradually become an important means to express and inherit culture. CAD technology provides powerful support and unlimited possibilities for digital art creation. Especially, in the digital art inheritance of ICH culture, image processing algorithm plays a vital role. ICH culture includes various folk dances, traditional handicrafts and folk activities, and these cultural forms are usually rich in texture, color and shape. In digital art, these characteristics need to be carefully captured and reproduced to maintain the unique charm and historical value of ICH culture. Image processing algorithm can effectively process and analyze these image data and extract key features, such as color, shape and texture. In addition, these algorithms can also transform and process images in various forms to meet the needs of digital art creation. In the CAD design of ICH digital art, image processing algorithm plays a core role. It helps researchers to better understand and use the information in ICH images, and at the same time provides unlimited possibilities for digital art creation. By combining advanced computer technology with the essence of ICH culture, the unique charm of ICH culture can be preserved, spread and displayed in an unprecedented way.

In CAD design, key features in ICH images can be effectively extracted by using image processing algorithms, such as feature detection based on wavelet transform. Wavelet transform can decompose an image into sub-images of multiple frequency bands, and each sub-image corresponds to the characteristics of an image in a scale or a direction. By choosing the appropriate wavelet basis function, texture and shape. These features can be used to create digital models, and then carry out subsequent processing such as 3D printing and animation design. The image matching algorithm characteristics of wavelet to match images on different scales in order to obtain better matching effect. Moreover, the mosaic algorithm based on wavelet transform can make use of the time-frequency localization characteristics of wavelet transform to finely adjust and process the mosaic part of the image to ensure the smoothness and continuity of mosaic. See Figure 1 for the identification and fitting process of artistic image data.

By using deep learning algorithm and wavelet transform technology, we can learn deep feature expression from ICH images, and then generate high-quality 3D models. WNN is an image processing method that combines wavelet transform and neural network. It can make use of the multi-scale characteristics of wavelet transform and the adaptive learning ability of neural network to effectively extract and classify images. WNN can be applied to 3D model construction. Through multi-scale analysis and processing of ICH images, its feature information is extracted, and then the neural network is used to generate and learn 3D models. This can provide more possibilities for the CAD design of ICH digital art. Remember that the probability of a random event is $P(E)$, so the amount of information it contains is:

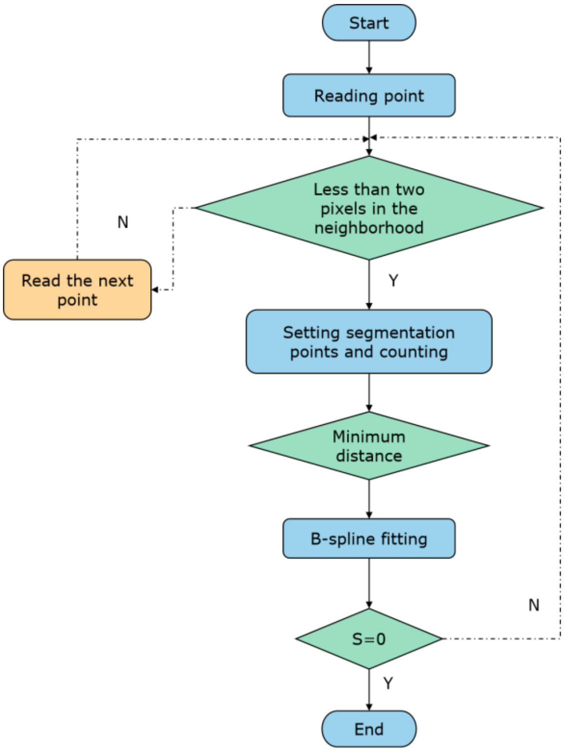


Figure 1: Art image data identification and fitting process.

$$I(E) = \log \frac{1}{P(E)} = -\log P(E) \tag{1}$$

An image can be regarded as a source with random output, which can generate a symbol sequence from a limited symbol set. The source symbol set defines B as the set $\{b_i\}$ of all possible symbols, where each element b_i is called the source symbol, and the probability that the source generates symbol b_i is $P(b_i)$.

The self-information of the single symbol b_i generated by the source is:

$$I(b_i) = -\log P(b_i) \tag{2}$$

If the source generates k symbols, the symbol b_i will generate $kP(b_i)$ times on average. If the average information output by each source is recorded as $H(u)$, then:

$$H(u) = \sum_{i=1}^{n} P(b_i) \cdot I[P(b_i)] = -\sum_{i=1}^{n} P(b_i) \log P(b_i) \tag{3}$$

$H(u)$ is called the entropy of the source, which defines the average amount of information obtained when a single source symbol is observed.

A source whose symbol set B and the occurrence probability of each symbol are known, and whose symbol statistics are independent, is called a zero-memory source. If its output is n 1-group symbols obtained from the source symbol set, the source output is a 1-group random variable. This random variable takes one of the sets of all n element series, and this value is recorded as β_i. Each β_i consists of n symbols in B, and the probability of β_i generated by the source is $P(\beta_i)$, which is obtained by multiplying the single symbol probability $P(b_{ik})$:

$$P(\beta_i) = P(b_{i1})P(b_{i2})\dots P(b_{in}) \tag{4}$$

The $H(u')$ of the source is:

$$H(u') = -\sum_{i=1}^{J^n} P(\beta_i)\log P(\beta_i) = nH(u) \tag{5}$$

It can be seen that the entropy of the zero-memory source generating block random variables is n times that of the corresponding single-symbol source. It can also be regarded as an n-order extension of single-symbol sources.

The inter-frame difference algorithm based on wavelet transform can further detect the dynamic changes in the image and make animation. The algorithm can use the multi-scale characteristics of wavelet transform to detect and calculate the differences between adjacent frames on different scales, so as to obtain more accurate and detailed dynamic change information. Then, according to this information, we can design and make animation works by interpolation, synthesis and other technical means. Nested combination is to integrate the operation. Its structure is shown in Figure 2, in which the excitation function of hidden layer is wavelet function.

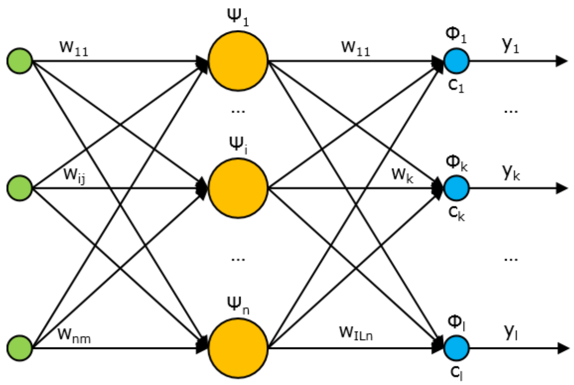


Figure 2: Embedded WNN structure.

Wavelet network can play the role of clustering, but it can't be directly classified or identified. In the Learning Vector Quantization (LVQ) algorithm, teachers' signals are added as classification information to fine-tune the weights, and the output neurons are assigned their categories in advance. LVQ can be regarded as an extension of wavelet algorithm. Its basic idea comes from wavelet algorithm, and its corresponding network structure is very similar to wavelet, but there is no specific topological structure like wavelet. In the learning process, the input vectors are classified into groups by neurons in the competition layer, and then they are combined into expected types by the linear layer, and it is guaranteed that only one output neuron in the linear layer has a non-zero output value of 1 at any time. In concrete work, LVQ network classifies the input vector into its closest class.

In Figure 3, the schematic diagram of LVQ network structure is given. In order to facilitate understanding, the competition layer is drawn as a one-dimensional array organization. In fact, the competition layer can also have various arrangements, usually a two-dimensional planar array structure.

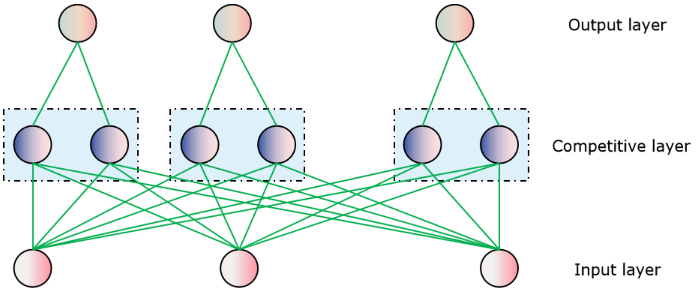


Figure 3: LVQ network structure.

$$\nabla f(x,y) = [G_x, G_y]^T = \left[\frac{\partial f}{\partial x} \frac{\partial f}{\partial y}\right]^T \tag{6}$$

Where G_x and G_y are gradients along the direction x and y, respectively, and the amplitude $|\nabla f(x,y)|$ and direction angle of the gradient are:

$$|\nabla f(x,y)| = \left(G_x^2 + G_y^2\right)^{1/2} \tag{7}$$

$$\varphi(x,y) = \arctan\left(\frac{G_y}{G_x}\right) \tag{8}$$

For digital images, the amplitude $|\nabla f(x,y)|$ of the gradient of the above formula can be replaced by differential and used as the value of each pixel of the formed image:

$$|\nabla f(x,y)| = \left\{[f(x,y) - f(x+1,y)]^2 + f(x,y) - [f(x,y+1)]^2\right\}^{1/2} \tag{9}$$

The above formula is the mathematical expression of difference, which is accomplished by operators in engineering.

ICH digital art works usually contain rich texture, color and shape information, which is the key for artists to express their emotions and creative intentions. By combining wavelet transform with neural network, the feature information of ICH image can be extracted and processed better, which provides more possibilities for CAD design. WNN can decompose the image into sub-images of multiple frequency bands through multi-scale analysis, so as to extract the features in each sub-image. These features can include color, texture and shape, and they can be used to create digital models, and then carry out subsequent processing such as 3D printing and animation design. By combining wavelet transform with neural network, the feature information of ICH image can be better extracted and processed, so as to design and make animation works.

4 COMPUTER SIMULATION EXPERIMENT AND RESULT ANALYSIS

Digital images from different types of ICH projects are used as experimental data. These images include folk dances, traditional handicrafts and folk activities. When collecting these images, we pay attention to the diversity and coverage of the images to ensure the generalization performance of the algorithm. Moreover, it also ensures the quality and clarity of the image, so as to facilitate the subsequent feature detection and processing. In order to carry out the experiment, an experimental platform based on computer vision and deep learning technology was built. The platform includes a high-performance computer, a display, a data storage device and a programming software environment. Python programming language and TensorFlow, a deep learning framework, are used to write and implement the algorithm.

For the training set, wavelet transform technology is used to extract image features, and these features are used as input to train through neural network. In the training process, the random gradient descent (SGD) algorithm is used for optimization, and the appropriate training period and learning rate are set. After the training is completed, the test set is used to verify the algorithm. Firstly, the features of each image in the test set are extracted, and then these features are input into the trained neural network for classification and prediction. Finally, the predicted results are compared with the real labels to evaluate the accuracy and generalization performance of the algorithm.

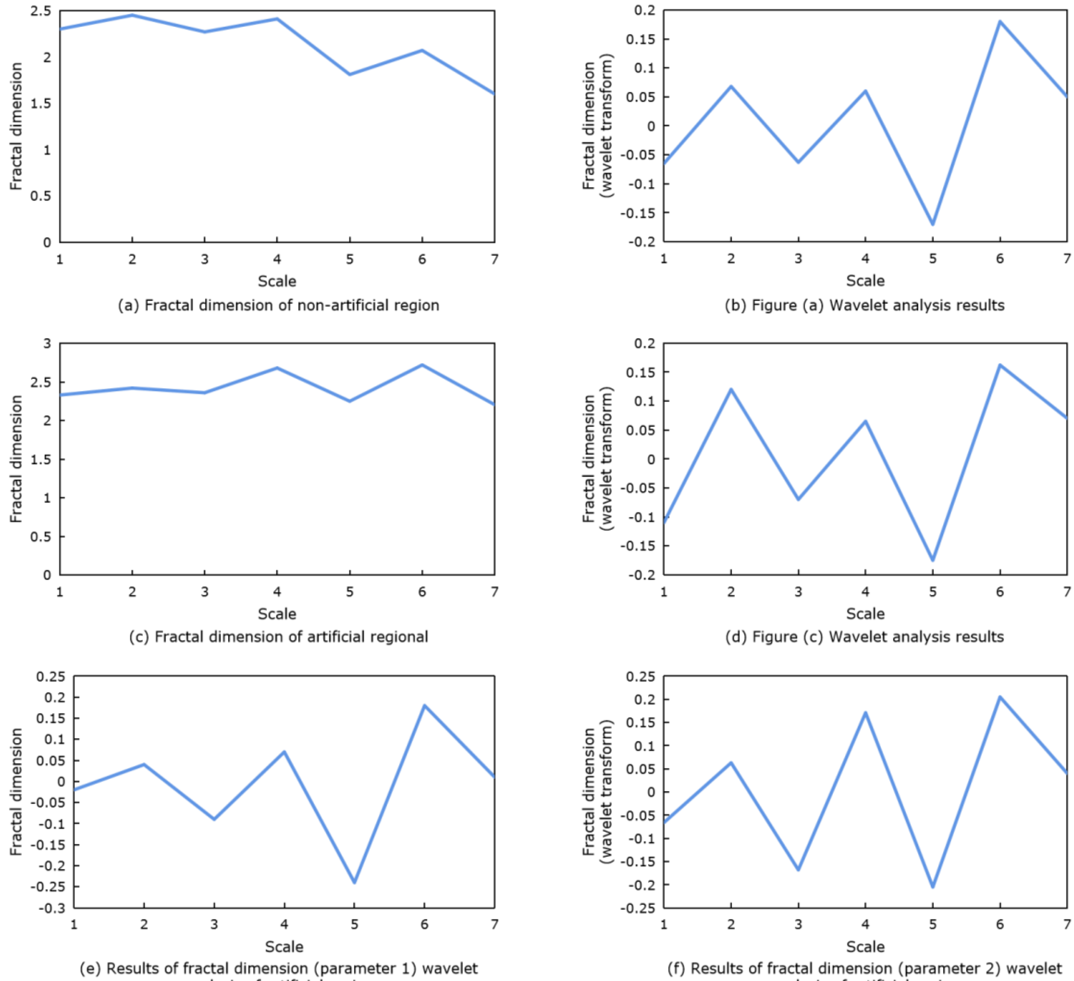
The original test images are digital images of ICH culture, which may come from different types of folk dances, traditional handicrafts and folk activities. These images are usually rich in texture, color and shape information, which can reflect the unique charm and historical value of ICH culture. During the test, these images are processed by WNN algorithm. The original test chart and the result chart are shown in Figure 4.

(a) Original image (b) Segmentation result

Figure 4: Test results.

The fractal dimension of the low-frequency part is calculated by two parameters respectively, and the approximate areas of artificial and non-artificial areas under the two parameters can be obtained, and the mathematical morphology operation is carried out, and then the fractal dimension characteristics of high-frequency information in the other three directions of these areas are calculated to further determine their respective regional sets. The calculation process and data analysis are further illustrated by Figure 5.

By using the mathematical tool of fractal dimension, this article will focus on the changes of key elements such as texture, shape and structure in ICH images under different parameters. The fractal dimension information of different elements at different scales can be obtained by wavelet transform of ICH images. Observing these data, we can find that there are significant differences between artificial and non-artificial objects (such as natural scenes, buildings, etc.), and this difference is particularly obvious in the oscillation situation after wavelet transform. By setting appropriate thresholds, these different elements can be effectively distinguished and identified. In addition, the range and shape of specific elements (such as handicrafts, dance performances, etc.) in the image can be further determined by using mathematical morphological operations and gray information. By analyzing the fractal dimension changes of these elements under different parameters, we can understand their visual characteristics and structural characteristics at different scales, and then provide useful reference for the protection, inheritance and growth of ICH.



(a) Fractal dimension of non-artificial region
(b) Figure (a) Wavelet analysis results
(c) Fractal dimension of artificial regional
(d) Figure (c) Wavelet analysis results
(e) Results of fractal dimension (parameter 1) wavelet analysis of artificial region
(f) Results of fractal dimension (parameter 2) wavelet analysis of artificial region

Figure 5: Data analysis of test process.

Compare the output parameters of the image processing algorithm with the real ICH image feature parameters, as shown in Figure 6. By comparing the output parameters of the image processing algorithm with the feature parameters of the real ICH image, we can evaluate the accuracy and effect of the algorithm and understand the performance of the algorithm in feature detection of ICH images.

According to the results shown in Figure 6, the feature parameters output by the image processing algorithm are very close to those of the real ICH image. This means that the algorithm can effectively extract key features from ICH images, including texture, color, shape and so on. These features are important elements of ICH digital art creation, so the accuracy and reliability of this algorithm are of great significance to the digital protection and inheritance of ICH culture.

High-precision classification provides the possibility for the application of ICH in real life, such as tourism development, cultural and creative product design and other fields. Digital files of ICH images can be established through high-precision classification. Figure 7 tests the classification accuracy of the algorithm for three different types of ICH images.

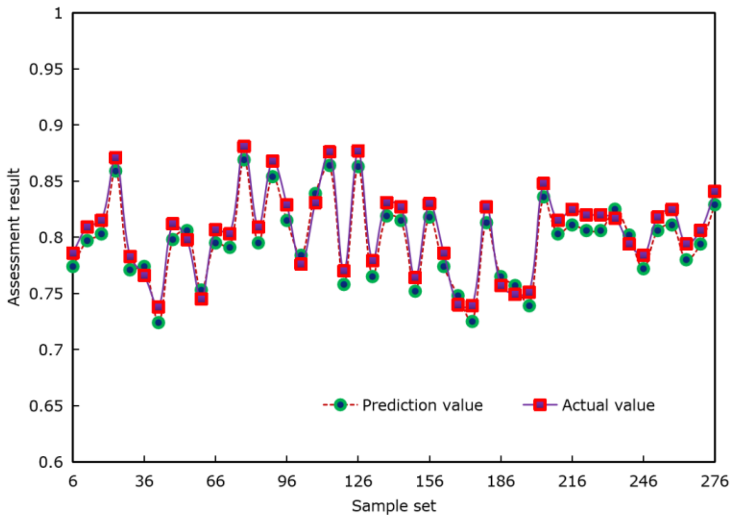


Figure 6: Learning results of image processing algorithm.

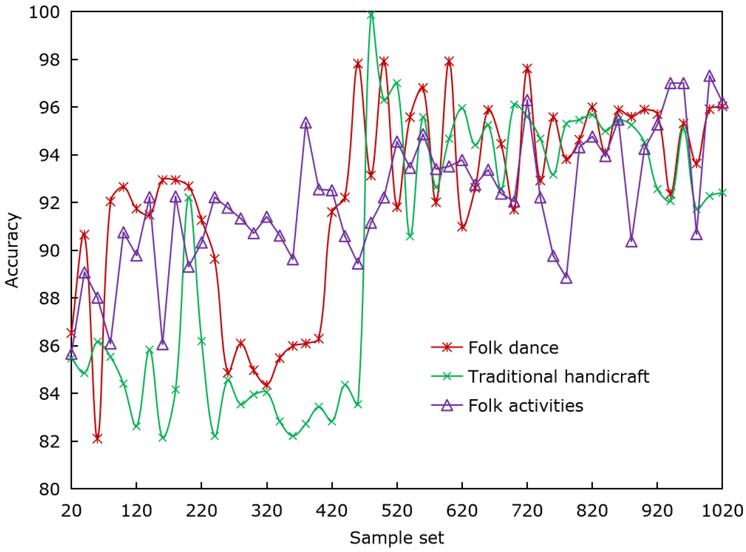


Figure 7: ICH image classification accuracy of WNN.

In the classification of folkdance images, the accuracy of the algorithm reached 93.2%, which means that the algorithm can accurately distinguish various folkdance images, such as Yangko and Mongolian dance. In the classification of traditional handicraft images, the accuracy of the algorithm is as high as 92.8%, which shows that the algorithm can accurately identify different types of traditional handicraft images, including ceramic making, paper cutting and so on. In the image classification of folk activities, the accuracy of the algorithm reaches 91.5%, which shows that the algorithm can accurately distinguish various folk activities images, such as Spring Festival and Dragon Boat Festival. Using WNN's image classification algorithm, the classification accuracy of ICH images of folk dance, traditional handicrafts and folk activities all exceeds 90%, which proves that the algorithm has excellent classification ability and generalization performance, and can be effectively applied to ICH image classification and recognition tasks.

5 CONCLUSIONS

ICH not only carries the cultural tradition and history of a nation or region, but also is an important pillar of people's cultural identity and national spirit. The main purpose of applying image processing algorithm in ICH digital art CAD design is to better capture and reproduce the unique charm of ICH culture image processing algorithm in ICH digital art CAD design. Firstly, the importance of image processing algorithm and its influence on ICH digital art are introduced. Then, the principle of WNN algorithm and its application in ICH digital art are expounded. By using WNN algorithm, we can better extract the and shape. These features can be used to create digital models, and then carry out subsequent processing such as 3D printing and animation design. In the image classification of folk activities, the accuracy of the algorithm reaches 91.5%, which shows that the algorithm can accurately distinguish various folk activities images, such as Spring Festival and Dragon Boat Festival. Using WNN's image classification algorithm, the classification accuracy of ICH images of folk dance, traditional handicrafts and folk activities all exceeds 90%, which proves that the algorithm has excellent classification ability and generalization performance, and can be effectively applied to ICH image classification and recognition tasks.

Image processing algorithm has a wide application prospect in ICH digital art CAD design. The WNN algorithm proposed in this article provides more possibilities for ICH digital art creation, and provides new ideas and methods for the protection and inheritance of ICH culture. According to the characteristics of different ICH digital works of art, we can further study how to optimize the parameters of the algorithm. For example, in image matching and stitching, we can choose more suitable matching algorithm and wavelet basis function to improve the accuracy and efficiency of matching.

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