

Research Article

Research on the Performance of Impressionist Painting Color Visual Communication Based on Wireless Communication and Machine Vision

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In order to solve the problem of poor visual communication effect of impressionist painting colors and low accuracy of painting color enhancement by existing methods, this thesis proposes a research on the performance of impressionist painting color visual communication based on machine vision under the background of wireless network. This method can improve the vision, speed, and efficiency of communication, through the analysis of the characteristics of impressionist paintings, and determine the visual communication objects of impressionist painting colors. The process of visual communication is analyzed, and the color matching of impressionist painting is completed with the help of BP neural network algorithm. On this basis, the histogram method is used to process the image brightness of impressionist paintings, the image interpolation method is used to process the image brightness of impressionist paintings, and the image is corrected by gamma correction to complete the image performance research. The color vision communication of impressionist painting needs to correct the gray scale error of impressionist painting and enhance the color of impressionist painting. The experimental results show that the accuracy of this method for the color matching of impressionist painting images is about 98%, which has a certain degree of credibility.

1. Introduction

The development of impressionist art has been well known in the world, and its influence has spread to all continents. In the history, there are countless research studies on impressionist painting at home and abroad. With the rapid development of cultural industry, the demand for impressionist painting is increasing [1]. It makes people have higher requirements for the quantity and quality of impressionist paintings. In today's fast-paced living environment, the material conditions are sufficient, people's pursuit of spirit is more and more, entertainment and leisure has also become a very important part of life, the entertainment, interest, and appreciation of impressionist painting just meet people's needs, and the artistic value of impressionist painting is more and more recognized by people [2].

In recent years, with the development of wireless communication technology and software computer technology, impressionist painting industry began to grow. The

popularization of contemporary new media technology and photography technology provides a good technical support for the development of impressionist painting. Successful impressionist paintings need not only good technical support but also more innovative artistic connotation. In the history of art, there are many classic art schools, and the art forms created by them are well known. Impressionism came into being in the 19th century. As the beginning of modern art, it created an aesthetic taste different from that of classical art. It adapted to the needs of modern people's artistic taste and developed rapidly. Impressionist painting works have a unique style of modeling language, which emphasizes the bold use of color, thus producing a colorful sense of the picture. Impressionist painters use sketches to quickly capture the changes of impressions that are about to pass away, with random strokes, or dots, or lines [3]. The emergence of modern impressionist painting is also the product of the times. Impressionist painting art comes from painting art, but there are also differences. In modern

impressionist paintings, there are many references and applications to traditional painting art, and the application of impressionist painting elements in modern scenes is also constantly emerging, including many applications [4]. Therefore, the research on color visual communication of impressionist painting has become a hot topic.

In reference [5], a color image enhancement method based on Lab color space and tone mapping is proposed. Aiming at the problems of detail preservation and color constancy in low illumination image contrast enhancement, a novel Retinex image contrast enhancement algorithm based on Lab color space and tone mapping is proposed. Firstly, a low-contrast input image is decomposed into luminance and chrominance components in Lab color space, and adaptive bilateral filtering is used to estimate the illumination intensity, so as to consider the appropriate adjacent pixels according to the luminance and color values. Then, the parabola-based tone mapping function is used to improve the contrast of the estimated illumination image. Finally, the enhanced brightness is combined with the original chroma to produce an enhanced color output image. The proposed algorithm enhances the details and edge structure of the image by reducing the image artifacts and preserves the naturalness of the image by avoiding color shift. However, the application of this method to the color visual communication of impressionist painting has some problems, such as poor communication effect, which still needs further improvement. In reference [6], a bionic visual image enhancement method based on top cap and bottom cap transformation is proposed. Aiming at the problems of low contrast, blurred details, and low color saturation in low illumination images, the method analyzes the nonlinear relationship between subjective brightness perception and light intensity of human eyes and the transmission characteristics of receptive field in retinal ganglion cells of human eyes. A bionic image enhancement algorithm based on top hat transform and bottom HAT transform is proposed. Firstly, the RGB (red, green, blue) color space of low illumination image is transformed into HSV (hue, saturation, brightness) space, and the global brightness logarithm transform of brightness component V is carried out. Secondly, the contrast of local edge of image is adjusted by three Gaussian models of retinal neuron receptive field. Finally, according to the top hat transformation and the bottom hat transformation, the background of the light is extracted. The details of the low illumination image enhanced by this method are relatively clear, and the application of this method to the color enhancement of impressionist painting can improve the painting color, but the visual communication factors considered in the image enhancement are less, which has some limitations. In reference [7], an image enhancement and color correction model based on homomorphic filtering is proposed. In order to solve the problem of image brightness and color distortion, an underwater image enhancement and color correction model based on homomorphic filtering is proposed. Firstly, an underwater imaging model is constructed by using Beer–Lambert law and path radiation component. The image without attenuation is estimated by homomorphic filtering. Finally, the imaging model is expanded by McLaughlin series, and then a color correction

model is derived to keep the color constant. Through the correction of the model, the image color is enhanced, but there are still some limitations.

Based on the problems in the above methods, this paper proposes a new performance research method of impressionist painting color visual communication based on machine vision.

The research content of this paper is as follows:

- (1) The research on the color visual transmission performance of impressionist painting based on machine vision under the background of wireless network is proposed.
- (2) By analyzing the characteristics of impressionist paintings, we determine the visual communication objects of impressionist painting colors.
- (3) We analyze the process of visual communication and complete the color matching of impressionist paintings with the help of BP neural network algorithm.
- (4) We use the histogram method to process the image brightness of the impressionist paintings, use the image interpolation method to process the image brightness of the impressionist paintings, and correct the image through gamma correction to complete the image performance research.

2. An Analysis of the Artistic Characteristics of Impressionist Painting

Impressionism came into being in France in 1860–70s. It has innovative painting ideas. Impressionist painters advocate going out of the room, going into the nature, directly sketching in the natural light, and paying more attention to the color, light, and brushwork of the picture than to the content of history, ethics, and other subjects. They describe objective things objectively and scientifically from different directions with new perspectives and strongly oppose the rules of college art. Impressionism is a turning point in the history of art and the beginning of modernism. The name of impressionism comes from the first exhibition. At that time, Monet, Renoir, Bisharo, Sisley, Degas, Cezanne, Morrisol, Kiyoman, and others participated in the exhibition. The critic Louis leruwa used the title of Monet's oil painting "impression of sunrise" as a satire in his article, calling the exhibition "the exhibition of impressionist painters," which gave the impressionism its name [8]. Although the impressionist exhibitions at the beginning were full of fierce criticism and malicious ridicule, they also caused a sensation in the society. The middle class audience also saw the consciousness and art of freedom, as well as the yearning for free life. From then on, European painters tried to get rid of the shackles of the original painting concept and pay more attention to the painting language itself.

2.1. Color Contrast Study. Impressionist artists can well show the bright and dark color expression of the painted objects, and the feeling of color is very rich, and the sense of

picture is also very strong, lively, and full of life. Impressionist painting mainly uses strong and bright colors and bold light. Especially in the dark part of the picture, bright and bold blue purple is used to replace black brown in the traditional painting. The research and expression of light in painting is the main concern of impressionist painting, so that painters do not pay attention to too clear and solid sketch relationship but use fuzzy and virtual contour to replace it [9]. Instead of time-consuming detail description, bold colors are used to construct the body structure of objects. Therefore, when we observe impressionist paintings from a close distance, we will find that the picture is composed of many messy lines and color blocks, and the strokes give us a very scribble feeling. However, when we observe impressionist paintings from a distance, it will bring us a very strong light effect.

2.2. Objective Representation to Subjective Representation. Barbizon school makes light and color in painting expressed, and impressionist painters have a further exploration of light and color in nature on this basis. Impressionist painting opened the direction of diversified development of painting, and painters no longer simply describe the objective existence of nature but put more emotions into the painted object, thus becoming a kind of personal emotional catharsis. Painting has become more and more free and diversified. It can be said that impressionism has changed the traditional European painting concept and redefined the social function of art. Instead of taking the serious theme in traditional painting as the only choice, religious theme and historical theme are no longer the dominant painting themes [10]. Free expression of the current real life has become a way of objective representation, which does not rely on narrative expression and pursues the direct feeling of the current things. Painting is no longer the traditional narrative way of religion, politics, and literature. Painting is closer to its most essential spiritual realm. It can be said that impressionist painters, in their efforts to explore the art of painting, pioneered the objective representation of painting into subjective spiritual expression and created an aesthetic form suitable for the development of the times. Impressionist paintings adapt to the aesthetic needs of the social class at that time, so as to more clearly express the aesthetic principles of impressionist painting. However, it should be noted that impressionism does not oppose the imitation of nature but pays more attention to the instant feeling of the first impression when imitating nature. Bissallo once said: “we should observe more for plane rather than sketch, and we should not lose the initial impression at the end of painting” [11].

2.3. Using Scientific Principles of Color Creation. As the main expression of new impressionism, stippling can make the picture reach the highest purity and fresh tone and create a bright visual feeling. Moreover, it further shows the clear concept of order on the screen. The color of dot color painting is based on the color matching method created by impressionist painters, and through

their own exploration and improvement, they used the principle of optical science experiment to reconcile different and pure color points to form a new optical color matching method. For example, Seurat’s oil painting “Sunday afternoon on big bowl island” studied the theoretical creation knowledge of “stippling” by combining the interaction of environment and sunlight and creating the toning effect by matching the color dots on the canvas. His novel artistic charm shocked the whole painting world at that time. The tranquil and harmonious colors of the work create a beautiful weekend afternoon in midsummer. On the lawn of big bowl island near Paris, visitors have different postures, bathed in sunshine and immersed in comfortable environment and beautiful life.

3. A Study on the Expression of Impressionist Painting Color Visual Communication in Machine Vision

3.1. Analysis of Visual Communication Process of Impressionist Painting Color. Visual communication is based on human visual organs to identify things in the living environment. Most of the external information obtained by humans is obtained through the visual system. Visual media help humans to understand the world. The visual system receives external information by receiving external visual symbols. This process is a visual communication process, and its essence is the transmission of information. Among them, visual conformity and communication are the core of visual communication. Visual symbol is the carrier of information, which can objectively show the existence of information; communication is the transmission of information, which is the process of transmission from the sender to the receiver. The process of visual communication is from sender to medium to receiver [12], and the process is shown in Figure 1.

As can be seen from Figure 1, the sender converts the information into visual symbols according to the information to be conveyed. The medium is the carrier of both. The receiver analyzes the received information. All links need to be supported by data. In the visual communication of impressionist painting colors, the first thing to consider is the intensity of painting colors, and the information conveyed should follow the rules of visual communication.

3.2. Realization of Impressionist Painting Color Visual Communication Based on Machine Vision

3.2.1. A Study on Color Matching of Impressionist Painting Based on BP Neural Network. The exciting point, color area, line thickness, and other factors of impressionist painting will affect the balance of its layout. A large number of research results show that the visual effect of impressionist painting affects the browsing time. In impressionist painting, adding a unique color [13] can enhance the personalization of painting and attract more readers. This paper uses BP neural network to color impressionist paintings.

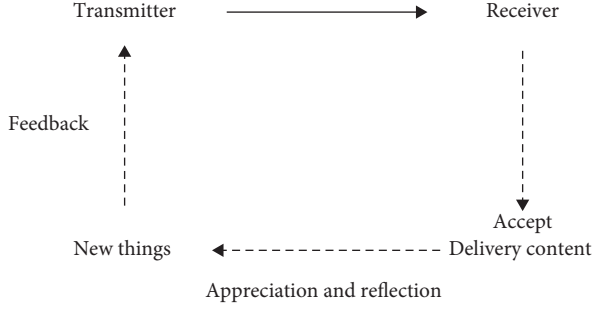


FIGURE 1: Visual communication process.

An impressionist painting color matching target value is set in the hidden layer in the BP neural network, that is:

$$A_i = \bar{\omega}_i^* b_{i-1} + \psi c_i, \quad (1)$$

in which i is the number of layers that indicate the color matching of impressionist paintings, $\bar{\omega}_i^*$ represents the color matching weight coefficient, b_i and c_i represent different areas of impressionist painting color matching, and ψ are neurons representing BP neural networks. Among them, $\psi = [\psi_{i1}, \psi_{i2}, \dots, \psi_{in}]$.

Reset the hidden layer of the BP neural network, that is:

$$A_i^+ = \bar{\omega}_i + \psi d_i, \quad (2)$$

in which d_i represents the impressionist painting color matching area after BP neural network hidden layer reset and $\psi d_i = [\psi d_{i1}, \psi d_{i2}, \dots, \psi d_{in+1}]$.

On the basis of the above analysis, the network output of impressionist painting color matching is

$$S_i^+ = (\bar{\omega}_i^T + \psi d_i^T) S_{i-1}, \quad (3)$$

in which S_i represents the number of impressionist paintings' matching colors. Match the objective function of impressionist painting color through differential weight, we can obtain the required impressionist painting color matching [14], that is,

$$\frac{\partial S_i}{\partial ik} = -\psi^2 \sum_{i=1}^n [(\eta_i)^2 - d_i((S_{i-1})_j)] (S_{i-1})_j, \quad (4)$$

in which η_i represents the output dimension between the first output in impressionist painting color matching.

3.2.2. Impressionist Painting Color Enhanced. On this basis, the impressionist painting image is enhanced. Histogram has obvious effect on uneven image brightness distribution, and it can complete image processing through limited resources.

Assuming that the gray-brightness mapping of impressionist paintings is L i of simple mapping relationships L_i , N_i can be used to calculate the minimum distinguishable luminance difference ΔL_i of the human eye near the corresponding luminance value of the gray i . Assume that the two-dimensional gray matrix of gray image in impressionist painting image is represented as $F(x, y)$ and brightness

before image enhancement using L_i mapping image is $L(x, y)$. For the purpose of making the adjacent gray level of impressionist painting image distinguishable, so as to achieve the human eye distinguishable display effect, the brightness difference of the adjacent gray level is set to the $\Delta L(i)$ level. At the same time, the image brightness after $\Delta L'(i)$ mapping is obtained, and there are

$$L'(i) = L(0) + \sum \Delta L(i). \quad (5)$$

Due to the limited number of gray levels, the image brightness after mapping is limited [15] in the process of user impressionist painting design. For enhancing the visual effect of impressionist painting image, the image is interpolated by impressionist painting brightness [16]. Because of the step error of gray level brightness in the process of image mapping from gray level to brightness $\delta(x, y)$, the real brightness of image pixels is the brightness of gray level mapping $L'(x, y)$ and luminance error $\delta(x, y)$. Then, the brightness of the map is corrected by the error of $L''(x, y)$:

$$L''(x, y) = L'(x, y) + \delta(x, y), \quad (6)$$

where $\delta(x, y)$ needs to be distributed in a natural state; sort the pixels of the same gray level, obtain the sorting ordinal number of all pixels in the same gray level, and calculate the step error $\delta(x, y)$:

$$\delta(x, y) = \frac{\Delta L(i)}{(j-1)} \times K. \quad (7)$$

$\Delta L(i)$ represents the minimum resolution brightness, i represents the gray value at the pixel, and j represents the total number of pixels.

According to the visual communication characteristics, the pixels in the same gray level are sorted according to the following rules [17].

For the purpose of making it easier to separate pixels from the local background without deepening the image noise points, the following sort factors are introduced $D(x, y)$:

$$D(x, y) = \begin{cases} 0, & |F(x, y) - \bar{F}(x, y)| \geq N[\bar{F}(x, y)], \\ \frac{1}{|F(x, y) - \bar{F}(x, y)|}, & |F(x, y) - \bar{F}(x, y)| < N[\bar{F}(x, y)], \end{cases} \quad (8)$$

in which $F(x, y)$ represents the gray value of pixel (x, y) and $N[\bar{F}(x, y)]$ represents the minimum gray level that can be distinguished near the gray value of the display screen. Among them, the set of all $F(x, y)$ pixels at the gray level is represented as the data M and all elements in M are arranged in ascending order by sorting factor $D(x, y)$.

Brightness values at the processed pixel (x, y) :

$$L''(x, y) = \frac{L''(x, y) + K(x, y)}{[|J(x, y) - 1| \times \Delta L F(x, y)]}. \quad (9)$$

After gamma correction, the gray-brightness relation can be approximated to some linear relation, and the linear relation is set as follows:

$$L(i) = L(0) + m \times i. \quad (10)$$

After the above operation, the enhanced impressionist painting image is

$$F^n(x, y) = \left[\sum_0^{i=F(x, y)} N(i) + K(x, y) \times \frac{N[F(x, y)]}{(J(x, y - 1))} \times \frac{256}{\sum N(i)} \right]. \quad (11)$$

4. Experimental Analysis

4.1. Experimental Environment. The experiment was carried out on the platform of Matlab, and the impressionist painting images were selected from Corel image database for visual communication research. The experimental operating system is Windows XP system, the system memory is 16 GB, 200 impressionist painting images are selected in the image database, a total of 10000 image features are extracted and trained, and the image dimension is reduced through the difference filter. The experimental values were obtained through several iterations.

4.2. Experimental Parameters. The experimental parameters are shown in Table 1.

4.3. Experimental Indicators. To verify the scientific effectiveness of the proposed method, the experiment is carried out by comparing the method of this paper with the method of literature [5] and the method of literature [6], in order to set the experimental index of the color matching accuracy and visual communication effect of the sample impressionist painting image. Among them, impressionist painting image color matching accuracy calculation formula is

$$\text{precision} = \frac{U_{\text{total}}}{U_n} \times 100\%, \quad (12)$$

in which U_{total} represents the total number of color matches in impressionist paintings and U_n represents the number of color matches in impressionistic painting images.

4.4. Analysis of Experimental Results

4.4.1. Analysis of Color Matching Accuracy of Impressionist Painting Images by Different Methods. In order to verify the effectiveness of the proposed method, the methods of this paper, literature [5], and literature [6] are analyzed experimentally to analyze the color matching accuracy of sample impressionist painting images. The experimental results are shown in Figure 2.

Figure 2 shows that with the change of iteration times, there are some differences in color matching accuracy of impressionist painting images by three methods, among

TABLE 1: Experimental parameters.

Parameter	Short-cut process
Image size (dpi)	256 × 256
Image noise (dB)	-2 ~ 2
Number of iterations (times)	20
Sample image number (sheet)	200
Sampling interval (s)	0.2

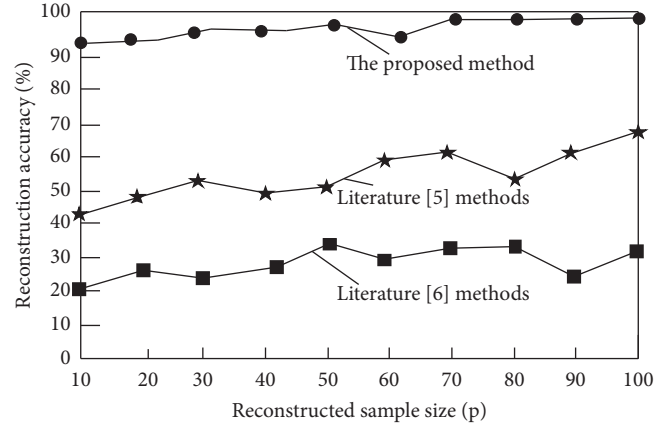


FIGURE 2: Analysis of color matching accuracy of impressionist painting images by different methods.

which, the highest color matching accuracy of this method is about 98%. The color matching accuracy of the other two methods is always lower than that of this method.

4.4.2. Visual Communication Effect of Impressionist Painting Images in Different Methods. To further verify the effect of the proposed method in visual communication of impressionist painting images, the experimental results are shown in Table 2 by analyzing the accuracy of this method, the method of literature [5], and the method of literature [6] in color enhancement of impressionist painting images of samples.

It can be seen from Table 2 that the visual communication effects of the three different model methods on the impressionist painting images are different. When the number of iterations is 60, the visual communication effect of this method is about 95%, the visual communication effect of document [5] is about 85%, and the visual communication effect of document [6] is about 84%. When the number of iterations is 100, the visual communication effect of this method is about 97%, and the visual communication effect of document [5] is about 86%. The visual communication effect of Yu et al. method [6] is about 82%, which proves the effectiveness of this method.

TABLE 2: Analysis of visual communication effect of impressionist painting images with different methods.

Number of iterations (times)	Methods of this paper (%)	Document [5] methodology (%)	Document [6] methodology (%)
20	98	78	89
40	97	84	85
60	95	85	84
80	95	75	84
100	97	86	82

5. Conclusion

This paper proposes the performance research of impressionist painting color visual communication based on machine vision under the background of wireless communication. Through the analysis of the characteristics of impressionist painting, the object of visual communication enhancement of impressionist painting color is determined; the visual communication process is analyzed, and the color matching of impressionist painting is completed with the help of BP neural network algorithm. On this basis, the histogram method is used to process the image brightness of impressionist painting, the image interpolation is used to process the image brightness of impressionist painting, and the gamma correction is used to correct the image. In order to complete the performance research of impressionist painting color visual communication, we need to correct the gray color of impressionist painting and enhance the color of impressionist painting. Compared with the traditional method, it has the following advantages. The color matching accuracy of this method is about 98%, which has a certain degree of credibility. The highest accuracy of this method is about 98%, which is feasible. Future research on visual communication and color analysis needs further research, especially on improving the ability of color reduction analysis.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The author declares that there are no conflicts of interest regarding the publication of this paper.

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