

## Research Article

# Art Visual Image Transmission Method Based on Cartesian Genetic Programming

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Received 21 October 2021; Revised 5 November 2021; Accepted 17 November 2021; Published 30 November 2021

Academic Editor: Bai Yuan Ding

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Because most of the traditional artistic visual image communication methods use the form of modeling and calculation, there are some problems such as long image processing time, low success rate of image visual communication, and poor visual effect. An artistic visual image communication method based on Cartesian genetic programming is proposed. The visual expression sensitivity difference method is introduced to process the image data, the neural network is used to identify the characteristics of the artistic visual image, the midpoint displacement method is used to remove the folds of the artistic visual image, and the processed image is formed under the above three links. The Cartesian genetic programming algorithm is used to encode the preprocessed image, improve the fitness function, select the algorithm to improve the operation, design the image rendering platform, input the processed image to the platform, and complete the artistic visual image transmission. The analysis of the experimental results shows that the image processing time of this method is short, the success rate of visual communication is high, and the image visual effect is good, which can obtain the image processing results satisfactory to users.

## 1. Introduction

In recent years, the worldwide informatization process has been accelerating, and the development of all kinds of data has shown a soaring trend. As a key type of data in all kinds of information, image data can more intuitively record the state of human life. The subsequent technical problems of data analysis have gradually attracted people's attention, which has promoted the development of image visual communication research [1–3]. Most of the traditional art visual image communication methods use the form of modeling and calculation. Although this method can model quickly, the modeling effect of art visual image is not very ideal and the visual image effect is blurred, which is a kind of damage to the art image itself. Therefore, it is necessary to design an effective art visual image communication method. In order to solve this problem, relevant scholars have proposed some optimization methods [4–6].

Reference [7] proposes a plane visual communication effect optimization method based on wavelet change, which decomposes the image and reconstructs the wavelet. In the

process of reconstruction, the modulus diagram and phase angle diagram are calculated, and the edge images of each scale are extracted. Through the edge image, the corresponding edge points of the semireconstructed image are enhanced. On the above basis, the graphic beautification vector of slip model is used for operation. In order to simplify the operation, the above operation method is transformed into simple mathematical operation, and the visual communication effect is optimized through the reflected light graphic mode. The experimental results show that the proposed method effectively improves the visual communication effect of the image, makes the color of the image more vivid and rich, and reduces the optimization cost, but there is a problem of long image processing time. Reference [8] proposes a plane visual communication design method based on user experience effect. Computer vision imaging technology is used to sample the image information of plane visual communication and combined with the edge contour extraction method to detect the image contour of plane visual communication design, so as to extract the multiscale local structure feature information of plane visual

image. According to the needs of user experience effect, the boundary feature detection and multilevel structure decomposition in the process of plane visual communication design are carried out, the low-level visual structure of plane visual communication design is reconstructed by the method of adjacent pixel information fusion, and the user experience effect evaluation model of plane visual design image is established. According to the user experience effect, realize the optimization of plane visual communication design. The simulation test results show that the user experience effect of plane visual communication design using this method is good and improves the design effect of plane visual communication, but there are some problems such as blurred image edge and poor visual effect. Reference [9] designed a visual communication system design of animated character graphics and images in virtual reality environment. In the hardware design, the adaptation parameters of the renderer motherboard were designed to optimize the experience of visual communication. In the software design, by introducing Sobel edge operator, the gray function is established to solve the gradient amplitude, and the threshold is selected to compare it to complete the recognition and thinning of the edge data of animated character graphics and images. Design the motion capture module, establish the behavior control model, generate and manage the motion capture files, and complete the overall design of the system. The experimental comparison shows that the motion of the animated characters constructed by the designed system is relatively consistent, which verifies the effectiveness of the design system, but the success rate of visual communication is low.

In order to improve the visual effect of artistic visual image, improve image processing efficiency, and improve the success rate of visual communication, this paper proposes an artistic visual image communication method based on Cartesian genetic programming. Cartesian genetic programming is different from other algorithms in evolutionary art. Its works can generally be used directly and have high market value. Therefore, compared with other algorithms, Cartesian genetic programming is an art design algorithm with high artistic value and market potential, which has been successfully used in the field of image design such as wallpaper design. This paper optimizes the visual communication effect of artistic visual image with the help of this algorithm, so as to improve the user experience effect and satisfaction.

## 2. Art Visual Image Preprocessing

*2.1. Artistic Visual Image Data Processing.* Before visual communication design, the artistic visual image is pre-processed first. In this paper, the imported visual expression sensitivity difference method is used to process image data. Firstly, the data information needs to be effectively calculated. The formula is

$$F_i = (x + y + z) \times \Delta x. \quad (1)$$

In the formula,  $F_i$  represents the validity, and generally the validity is a range value;  $x$ ,  $y$ , and  $z$ , respectively, represent the digitization of the length, width, and height of the image data. Through the validity calculation, data stability analysis can be performed, and the stabilized data can be converted again for easy use [10]; the formula is

$$K_i = F_i \times (v_2 - v_1) - \Delta x(a + b + c). \quad (2)$$

In the formula,  $a$ ,  $b$ , and  $c$  all represent the maximum value of the effective data function. After the conversion of the formula, the matching effect can be directly calculated.

Each image data has a specific visual expression matching value. The matching value represents the corresponding attribute feature, and the attribute feature coefficient is

$$E = \frac{1}{n} \sum_{i=1}^n \sum_{j=1}^m f_i w_j s_h. \quad (3)$$

In the formula,  $f_i$  represents the integration coefficient;  $w_j$  represents the attribute extraction coefficient;  $n$  represents the deployment function;  $m$  represents the order change function. In order to facilitate the positioning of pixels, the selected attributes need to be matched and converted:

$$h_{ij} = v_{ij} \times [\tau_n \Delta f_i (k - k_1)]. \quad (4)$$

In the formula,  $v_{ij}$  represents the coefficient value of the sensitivity and  $\tau_n$  represents the matching conversion coefficient. Through the restriction of conditions, the value of each pixel with a specific attribute can be measured, and the difference calculation can be carried out after the measurement. The formula is

$$r_{ik} = \sum_{i=1}^n \tau_n \Delta f_{ik} \times \mu_x \mu_y. \quad (5)$$

In the formula,  $\Delta f_{ik}$  represents the image distortion coefficient.

The difference calculation can calculate the pixel value of each frame, and the pixel filling is performed through the difference calculation to ensure the effect of the artistic visual image [11]. The filling calculation formula is

$$f(s) = \frac{\Delta f_{ik}(x(k) - v(k))}{G_n}. \quad (6)$$

In the formula,  $x(k)$  represents the regular area of the image;  $v(k)$  represents the irregular area; and  $G_n$  represents the connected area of the image.

Substituting formula (4) and formula (5) into formula (6), we can get

$$f(s) = h_{ij} + r_{ik} \frac{\int E(t) + x(k) dt}{H(s)}. \quad (7)$$

In the formula,  $H(s)$  represents the adjustment parameter and  $E(t)$  represents the similarity of the pixel structure.

The relationship between the area pixels and the actual design can be obtained by filling and sorting, and  $H(s)$  in the adjustment formula (7) can be used to adjust the filling effect. In order to ensure the accuracy of the filling position, it is also necessary to establish the frame frequency position. The formula is

$$q \begin{bmatrix} \alpha \\ \beta \\ \chi \\ l \end{bmatrix} = \begin{bmatrix} \alpha \\ \beta \\ \chi \\ l \end{bmatrix}, \quad q = 1, 2, \dots, m. \quad (8)$$

In the formula,  $\alpha$ ,  $\beta$ , and  $\chi$ , respectively, represent the value of the area coordinate length, width, and height, which can be adjusted through the conversion of logical coefficients; the coefficient  $U$  is obtained by actual calculation, and the calculation formula is

$$U = \frac{v_0^d}{(u_i + u_0)^d}. \quad (9)$$

In the formula,  $v_0^d$  represents the screen filling ratio;  $u_i$  represents the uniformity of the unit pixel; and  $u_0$  represents the primary color reuse area.

The result of formula (9) is a coordinate filling, which ensures that every coordinate can be estimated by the system. In the process of extracting features of artistic visual image data, it can effectively solve the problem of data instability or inconspicuous presentation [12].

**2.2. Feature Recognition of Artistic Visual Image.** The feature recognition of artistic visual image is based on the data processing results of artistic visual image to ensure the visual communication effect and further recognize the features of artistic visual image. This paper proposes an art visual image feature recognition method based on neural network [13]. Firstly, the global color feature and LBP texture feature of the image are extracted [14], the deep network is constructed to extract the object category feature and advanced emotion feature of the image, and the four features are fused to generate a feature vector  $C$ . Secondly, the feature vector  $C$  is input into the three-layer full connection layer BP neural network classifier constructed by full connection method to realize image high-level feature recognition [15].

Connecting the  $c_1$ ,  $c_2$ ,  $c_3$ , and  $c_4$  obtained through the BP neural network above to the BN layer (Batch Normalization) can not only speed up the convergence speed of the model, but also improve the classification effect. The features passing through the BN layer are called combined features, represented by vector  $C$ , and  $\oplus$  represents string connection, as shown in the following formula:

$$C = BN(c_1 \oplus c_2 \oplus c_3 \oplus c_4). \quad (10)$$

By inputting the combined feature  $C$  extracted above into the emotion recognition model [16], the emotion category of the image can be obtained. While the object category  $c_4$  in the combined feature is used as the emotion recognition feature, it also becomes the image object

category alone. The two parts of information are integrated to obtain a descriptive phrase containing image emotion and object semantic information [17].

The emotion recognition network  $F(U, \eta)$  is a neural network including two hidden layers and one output layer, as shown in the following formula:

$$F(U, \eta) = f^4 + f^3 + f^2 + f^1(U). \quad (11)$$

In the formula,  $\eta$  represents a set of parameters, including weights and offsets, which is the final output of the network, including the probabilities of different image categories.

Specifically, for a vector  $u^v = [u_1^v, u_2^v, \dots, u_n^v]$  in layer  $v$ , where  $u_j^v$  represents neurons in this layer, assuming that  $e_j^{v+1}$  represents the value of neuron  $j$  in layer  $v+1$ , it can be calculated by  $f^{v+1}(u^l)$ :

$$f^{v+1}(u^l) = \sum_{i=1}^N g_{v,c}^j + I_v^j. \quad (12)$$

In the formula,  $g_{v,c}^j$  represents the weight of neuron  $j$  in the connection layer;  $I_v^j$  represents the offset of neuron  $j$ ; and  $N$  represents the number of neurons. Input the value of neuron  $j$  into a nonlinear activation function  $\partial$  [18]:

$$u_j = \partial(P_v^j - P_{v,\max}). \quad (13)$$

Use a nonlinear activation function ReLu in the hidden layer of the neural network:

$$\partial_{\text{ReLU}}(u) = \max(0, u). \quad (14)$$

The output layer of the last layer uses the softmax activation function, so that the output of the last fully connected layer can be converted into a category of probability distribution  $T \in P^k$ ; then the sentiment classification probability of the image is

$$T_i = \sum_{i=1}^n \log_2 \left( 1 - \frac{P_d^i h_d}{T \log_2(1 + \gamma_d^i)} \right). \quad (15)$$

In the formula,  $\gamma_d^i$  represents the output of the fully connected layer. The loss function of the recognition probability is the multiclass cross-entropy loss function [19]:

$$\omega_d^i = \log_2(1 + \gamma_d^i). \quad (16)$$

In the training phase, the network weights are updated by backpropagating the gradients of all layers. In order to optimize this loss function, it can be achieved by using the SGD optimizer to optimize the weight of the network. The learning rate is set to 0.001, the momentum gradient descent parameter is set to 0.9, and the training model is started until the loss value no longer decreases, thereby realizing the feature recognition of artistic visual images.

**2.3. Defolding of Artistic Visual Images.** During the transformation of artistic visual image, it is possible to map multiple pixels in the reference image to the same point of the target image, which is the "wrinkle" phenomenon caused

by the change of visibility. Only by eliminating the wrinkle can the target image show the correct occlusion relationship. In order to ensure the transmission effect of artistic visual image, on the basis of identifying the image features, continue to process the image folds to improve the smoothness of the image. One method to eliminate wrinkles is to determine the scanning order of pixels in the reference art visual image to ensure that the points obscured by other points are always drawn first in the target image. This method is usually called back to front wrinkle elimination method, and occlusion compatibility algorithm is a back to front method. This article mainly uses the midpoint displacement method to achieve this goal. The following is a detailed description.

Suppose  $D_s$  and  $D_{s+1}$  are used to express the left and right end points of the initial line segment of the artistic visual image. The first iteration is achieved by random disturbance of the midpoint of the line segment. The coordinates of the midpoint of the line segment after the iteration are expressed by formula (17). It can be regarded as different control points:

$$D_{\text{mid}} = \frac{D_s + D_{s+1}}{2} + e(m)\zeta_{ij}. \quad (17)$$

In the formula,  $e(m)$  represents a random function; the variance and mean of the function are 1 and 0, respectively.  $\zeta_{ij}$  represents the amount of disturbance. The amount of disturbance decays at a double speed. If the predetermined threshold is greater than the length of the segmentation line or attenuates to the predetermined number of division layers, the attenuation will stop.

According to the above analysis, it is learned that the control points are not changed during the recursive refinement of the difference, so significant wrinkles are prone to appear around the control points when actually simulating the vision of the artistic visual image. Therefore, in order to improve the visual effect, such wrinkles need to be removed. Based on the sampling law, increase the spatial resolution of the artistic visual image according to twice the range [20], and the original viewpoint value will be affected and changed due to the increase of high-frequency component. At this time, use formula (18) to shift the control point:

$$Q_e = \frac{\sqrt{V^2 - P_e^2 x_k^2}}{D_{\text{mid}}}. \quad (18)$$

In the formula,  $V^2$  represents the image overlay area;  $P_e^2$  represents the edge chain width threshold; and  $x_k^2$  represents the image edge chain length threshold.

The wrinkles existing in the artistic visual image can be removed in the form of midpoint displacement, and only a small amount of calculation content can be added on the basis of the midpoint displacement method to achieve the goal of removing wrinkles. It shows that the processing steps of this method are relatively simple, which can not only realize the effective processing of the image, but also improve the efficiency of image processing.

### 3. Art Visual Image Communication Method Based on Cartesian Genetic Programming

As a relatively new form of evolutionary art, Cartesian genetic programming has greatly changed its evolutionary image. It creatively uses four-digit data as a gene meaning unit, including two-input data, one-reference function data, and one-parameter data. This makes the image output by Cartesian genetic programming related to the selected function, which can create a more aesthetic image with a strong sense of art [21].

**3.1. Coding.** Coding is the first step of Cartesian genetic programming, which directly affects the performance of the algorithm. Binary coding is the most commonly used coding in genetic algorithm. In this coding, only 0 and 1 numbers are allowed. It adopts the minimum character coding principle, which greatly simplifies the coding and decoding operation of the algorithm [22]. However, when binary coding is used to deal with [23] multidimensional and high-precision numerical optimization problems, the error of mapping continuous functions to discrete values cannot be well eliminated. Therefore, binary coding cannot directly reflect the real situation of specific practical problems, and the accuracy of processing problems is not high. Moreover, algorithms using binary coding often have problems such as too large individual length and too much memory at runtime. In view of the shortcomings of the above binary coding, in order to overcome the shortcomings of binary coding in solving the problem of discretization of continuous functions, an improved form of binary coding, gray code, is proposed. Assuming that the binary code of an individual is  $H = h_m h_{m-1}, \dots, h_2 h_1$  and the corresponding gray code is  $Q = q_m q_{m-1}, \dots, q_2 q_1$ , there is a relationship

$$\begin{cases} h_m = q_m, \\ |h_i(t) - h_i(t-1)| < k, \\ q_i(t-1) - q_i(t) \geq k. \end{cases} \quad (19)$$

Gray code not only inherits most of the advantages of binary coding, but also improves the local search ability of genetic algorithm.

**3.2. Improvement of Fitness Function.** In genetic algorithm, fitness is one of the main criteria for evaluating the advantages and disadvantages of individuals in the population. The algorithm carries out a series of subsequent genetic operations according to the size of individual fitness, and the main source of individual fitness is the fitness function, so the advantages and disadvantages of the fitness function are directly related to the evolutionary efficiency of the algorithm [24]. For the solution of real problems, especially for constrained optimization problems, penalty function [25] is a more used method. It can combine the objective function of the problem with constraints and finally form an objective function without constraints. This is the initial model of the fitness function of the algorithm. Attention should be paid to the following problems.

The fitness obtained from the fitness function must be greater than or equal to 0. At the same time, it is required that the optimization direction of the objective function should be consistent with the evolution direction of the fitness function used in the individual evolution algorithm. When actually using genetic algorithm to solve specific practical problems, different fitness functions have an important impact on the final convergence and convergence speed of the algorithm. The appropriate fitness function should be finally determined according to experience or algorithm analysis.

The fitness function of Cartesian genetic programming algorithm is different from that of ordinary genetic algorithm. It uses manual evaluation of each individual in the population to obtain the individual fitness, which is also one of the main characteristics of its “interaction.” The manual evaluation of each individual of each generation of population is too cumbersome and complex. Ordinary users may soon feel tired and then get bored. Even professionals may cause evaluation deviation because of the fatigue generated by long-term evaluation. When solving practical problems, users may not be able to distinguish the practical significance of the fitness given by themselves. For example, it is difficult for users to recognize the actual difference between two individuals with a fitness of 80 and 85. Therefore, users may have cognitive deviation when giving individuals actual fitness, resulting in inaccurate fitness given to individuals. In the interactive Cartesian genetic algorithm, users are only allowed to select better individuals in each generation, and the selected individuals have the highest fitness in modern times. In this way, users do not have to give specific fitness to each individual, the difficulty of evaluation is greatly reduced, the fatigue of users is alleviated, and then the accuracy of user evaluation is improved.

**3.3. Selection Algorithm Improvement.** The selection algorithm is to select the better individuals among the individuals who have been evaluated for fitness for subsequent genetic evolution; that is, select the individuals with high fitness as the parent generation of population evolution, which fully demonstrates the biological evolution idea of natural selection and survival of the fittest [26]. In interactive Cartesian genetic programming, the selection algorithm is based on manual evaluation of fitness, and excellent individuals have the same fitness. For this special individual fitness assignment, interactive Cartesian genetic programming adopts quasi-simulated annealing method.

The simulated annealing method records each generation of optimal individuals selected by users and establishes a dynamic database. With the increase of evolutionary algebra, the selection probability of the optimal individuals of each generation changes dynamically. The specific approach is to make the late generated population have a greater selection probability. Considering the noisy nature of manual selection, make the selection probability of each generation  $g$  equal and make the probability change in a ladder shape. The probability function used is

$$p(x) = \frac{1}{\sigma\sqrt{2g}} - \frac{(d_i - d_j)^t}{\sigma^2}. \quad (20)$$

In the formula,  $\sigma$  represents the use probability of the individual;  $t$  represents the number of iterations. Calculate the use probability of the optimal individual according to formula (21). The specific formula is

$$\sigma_h = \arg \max[\sigma(Z = z_1 | X = x)]. \quad (21)$$

For example, when the current algebra is 6 and 12 generations, the change trend of usage probability of each generation is shown in Figure 1 and 2.

As can be seen from Figures 1 and 2, with the increase of algebra, the selection probability increases step by step, and the probability of the last order is much greater than that of the previous orders, which greatly increases the possibility of the algorithm to select the latest generations of individuals when selecting individuals. Even if the selection probability of the previous generations decreases gradually, the algorithm also provides the possibility for its optimal individual to enter the crossover and mutation of the latest generation. Compared with interactive genetic algorithm, this algorithm increases the range of selecting individuals and expands from using only the previous generation optimal individuals for subsequent genetic evolution to using all the optimal individuals. The algorithm not only considers expanding the scope of individual use, but also solves the problem of use probability. It also introduces the artificial individual evaluation noise response mechanism, which can help users find satisfactory images faster without increasing the burden of users.

**3.4. Visual Effect Rendering.** Combined with the pre-processing results of artistic visual image and Cartesian genetic programming algorithm, the effective processing of image is realized. In order to further improve the display effect of image, the image visual effect is rendered [27–29]. After the construction of Cartesian genetic programming algorithm, an image rendering platform is designed according to the actual needs to render the visual effect of artistic visual images. The following steps are the design process of image rendering platform.

The hardware composition of the image rendering platform designed in this article is shown in Figure 3. Among them, GPU is a graphics processor that supports OpenGL, responsible for rendering list calculation processing tasks; CPU is 32 bits; embedded processors such as ARM9 can be used to execute graphics applications; DMA can send the rendering list to the GPU; the VGA/LCD controller is mainly used to generate the scan timing signal of the display [30–32]. The platform is equipped with two frame buffers, one for display and the other for saving GPU drawing results. The ping-pong operation between the two can ensure the efficient operation of the entire platform.

With the support of the image rendering platform shown in Figure 3, the visual rendering process of artistic visual image is described in detail:

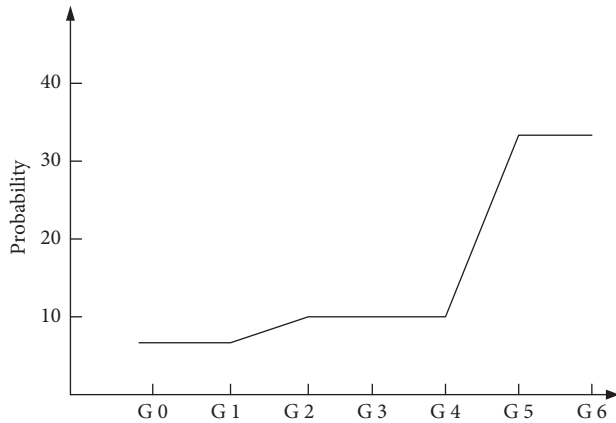


FIGURE 1: Change trend of generation 6 probability.

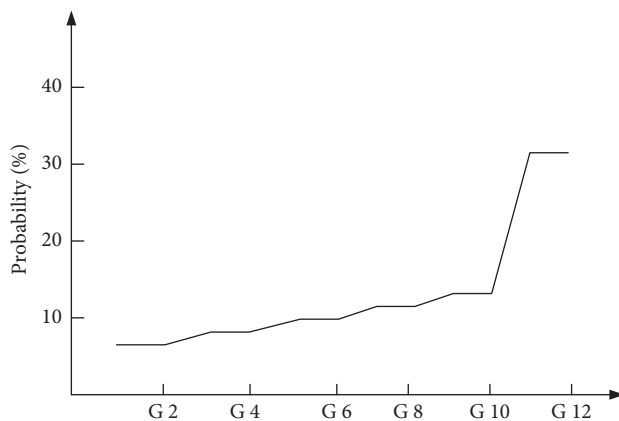


FIGURE 2: Change trend of generation 12 probability.

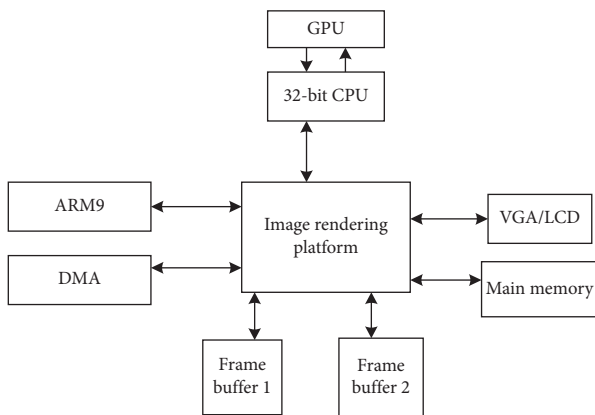


FIGURE 3: The hardware composition of the image rendering platform.

- (1) Initialize the image rendering platform, set the environment for artistic visual image operation in advance, build a common data area, and allocate the original length memory to each list in advance, so that each parameter can be initialized [33]
- (2) Definition file: read the artistic visual image file and store data in each list

- (3) Configuration platform: in order to facilitate the calling of artistic visual image scene during rendering, preprocess each scene
- (4) Display rendering results: obtain the state parameters generated by the platform itself and external input and control and display the objects in the scene, so as to optimize the display of artistic visual images and complete the visual communication design [34–36]

#### 4. Simulation Experiment

In order to verify the effectiveness of the art visual image communication method based on Cartesian genetic programming designed in this paper, comparative simulation experiments are used to compare the effect with the traditional art visual image communication methods, specifically the plane visual communication effect optimization method based on wavelet change and the plane visual communication design method based on user experience effect. In order to obtain more accurate experimental results, different methods are used to process an artistic visual portrait at the same time. Set the image conversion coefficient to 0.45. In order to better carry out the experiment, the image adjustment error is controlled within 0.2. At the same time, the plane visual communication effect optimization method based on wavelet change proposed in [7] and the plane visual communication design method based on user experience effect proposed in [8] are used as traditional comparison methods to compare with this method. Before the experimental test, it is necessary to prepare to build a test environment and prepare three computers. Before the experimental test, the three methods are installed in the three computers and put into trial operation. The three computers are jointly connected to a data analyzer. The analyzer completes the recording of experimental data during the test, so as to provide an accurate data basis for experimental analysis. In order to ensure the fairness of the experimental test and improve the test difficulty of the experiment, three levels of artistic visual images with low difficulty, normal difficulty, and high difficulty are randomly selected as the experimental samples in a three-image database before the experiment. At the same time, the total calculation sends image communication samples to the three systems to start the experiment. After all computers submit the artistic visual image dynamic communication report, the experiment is ended, the experimental data and experimental site are sorted out, the experimental analysis is completed, and the experimental conclusion is drawn.

*4.1. Experimental Dataset.* The images used in the experiment are from the Abstract dataset. The Abstract dataset contains 228 abstract paintings painted by professional painters. The image emotion is expressed through the combination of image color and texture and does not contain any recognizable objects. The emotional labels of the dataset were selected by 14 observers through voting. In order to obtain the annotation information of the dataset,



FIGURE 4: Sample experimental image.

the image is evaluated by peer rating on the network. 280 images were classified by 230 people for image emotion evaluation, in which each image would be marked by 14 people, and finally the category with the most votes from the eight categories was selected as the sample image. After analysis, some images with unclear categories were removed from the dataset, and finally a dataset composed of 228 images was generated. Some image examples are shown in Figure 4.

#### 4.2. Analysis of Experimental Results

**4.2.1. Comparison Chart of Image Sharpness.** First, take the image clarity as the experimental index, compare the traditional method with the method in this paper, randomly extract an image from the experimental image sample, and compare the image visual transmission effects of different methods. The result is shown in Figure 5.

It can be seen from the above pictures that the art visual image communication method based on Cartesian genetic programming designed in this paper can effectively solve the problem of unclear image. At the same time, it does not need to be revised in the process of visual communication and maintains the clarity of art image. As can be seen from Figure 5, in terms of image details, after using the method in this paper, the visual effect is clearer and the visual effect of the image is more realistic. After using the traditional method, the image shows blur effect, such as edge blur, high brightness, and so on. It can be seen that using this method has a better image visual communication effect.

**4.2.2. Comparison of Image Visual Transmission Efficiency.** Secondly, taking the image visual communication efficiency as the experimental index, different methods are compared, and the results are shown in Table 1.

By analyzing the data in Table 1, it can be seen that, with the increasing number of iterations, the image processing time of different methods gradually increases, indicating that the visual communication efficiency continues to decrease. Comparing the image processing time of this method with that of the traditional method, it can be seen that the image processing time of this method is much lower than that of the traditional method, and the minimum value of image processing time is 3.72s and the maximum value is only 4.80s; it is much lower than the traditional methods, which shows that the image visual communication efficiency of this method is higher. This is because this method uses the combination of image data and image processing platform to design and analyze the visual communication of images, accurately grasp the data status, reduce the image processing time, improve the visual communication efficiency, and obtain more accurate image data, so as to promote the analyzability of data and enhance the visual communication efficiency.

**4.2.3. Success Rate of Visual Communication.** Finally, taking the success rate of visual communication as the experimental index, the application effects of different methods are compared, and the results are shown in Figure 6.

According to Figure 6, compared with the traditional method, the image visual communication success rate of the method in this paper is higher, the highest value reaches

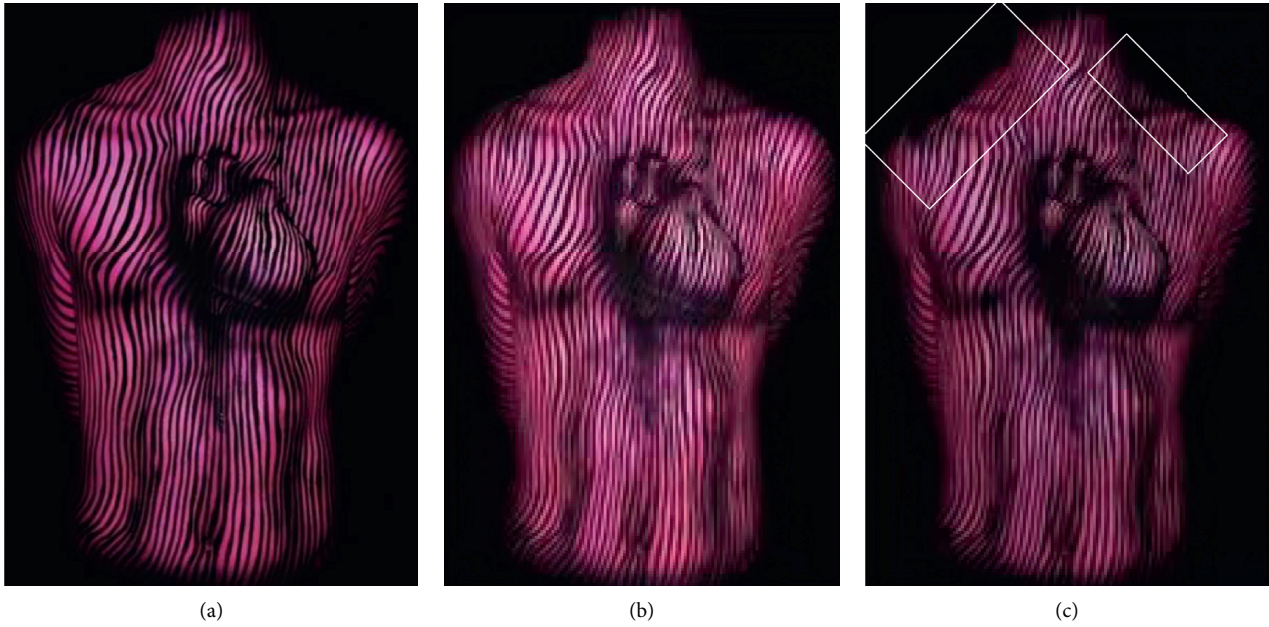


FIGURE 5: Visual communication effects of different methods.

TABLE 1: Comparison of image visual transmission efficiency.

Iterations (time)	Image processing time (s)		
	Method of this article	Image visual communication method based on wavelet transform	Image visual communication method based on user experience effect
1	3.72	7.12	5.37
2	3.82	7.36	5.62
3	3.91	7.89	5.98
4	4.05	8.12	6.37
5	4.16	8.25	6.24
6	4.20	8.56	6.70
7	4.37	8.91	7.05
8	4.59	9.13	7.19
9	4.72	9.47	7.54
10	4.80	9.84	8.90

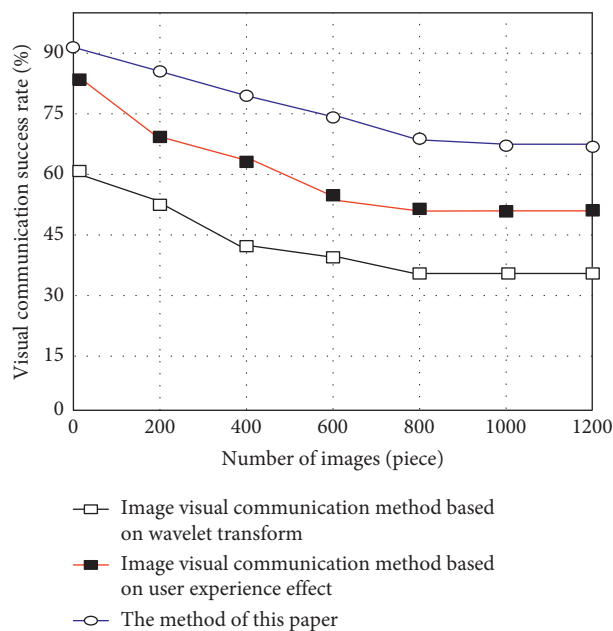


FIGURE 6: Comparison of the success rate of visual communication.



more than 90%, and the lowest value remains more than 65%. In contrast, the image visual communication success rate of the traditional method is lower.

To sum up, the art visual image communication method based on Cartesian genetic programming designed in this paper has a good effect, can improve the image visual communication performance to a certain extent, improve the clarity and integrity of the image, and has a good development prospect.

## 5. Conclusion

Aiming at the problems of long image processing time, low success rate of image visual communication, and poor visual effect in traditional methods, an art visual image communication method based on Cartesian genetic programming is proposed. The main innovations of this method are as follows:

- (1) This method can not only realize the effective image processing, but also improve the efficiency of image processing.
- (2) Cartesian genetic programming algorithm not only considers expanding the scope of individual use, but also solves the problem of use probability. It can help users find satisfactory images faster and improve the visual communication effect of images without increasing the burden of users.
- (3) The experimental results show that this method is superior to the traditional method in image processing time, image visual communication success rate, and visual effect, which shows that this method has higher application value.

The next research work can focus on how to extend this method to the case with multiple reference images, so as to improve the processing efficiency, make the communication results more consistent with the actual results, and be more suitable for practical application.

## Data Availability

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Conflicts of Interest

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

## Acknowledgments

This work was supported by A Study on Virtual Simulations Teaching Practices Based on "Production-Education Integration and Collaborative Education," 2021-R-87030.

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