Automatic Generation System of Computer Oil Painting Based on Red Spirit

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Abstract. In the oil painting creation in the direction of red spirit, the oil painting is generally in a realistic style, and the emphasis is on highlighting the historical stories in the oil painting. In the optimized creation of the red spirit, computer technology can be used to quickly complete the creation from historical images to oil paintings. In this paper, according to the requirements of the red spirit for optimized creation, an optimized generation system based on computer image processing technology is constructed. After the system receives and processes the original image, it can obtain sampling points in the form of a grid, and determine the optimized stroke direction, brush pixel value and radius according to the pixel value of the source image, and finally realize the conversion from other images to oil paintings. This system can improve the efficiency of red spirit oil painting creation, and can make the processed images have the characteristics of optimized drawing, so as to meet people's individual needs for oil painting creation.

Keywords: Oil Painting · Image Processing Technology · Computer · Red Spirit

1 Introduction

Among Chinese oil painting creations, oil painting creation with the theme of red spirit has always been the focus of development in the field of optimization. Most of the posters used to promote red essence on the streets are drawn using the art form of oil painting [1]. The red spirit oil painting emphasizes realism, and many oil paintings with the theme of red spirit are adapted from historical images or other portraits created by predecessors. As an important art form in the art field, oil painting has more advantages than other art forms in its three-dimensional sense and impact [2]. Therefore, in the process of promoting the red spirit, oil painting is usually used for creation, and oil painting is used as an art form. A remake of the Red Spirit story. In this paper, an oil painting automatic generation system is constructed according to the requirement of red spiritual oil painting creation. After the user inputs an image into the system, the system processes the original image, and finally outputs an image with oil brushstrokes [3]. The oil painting automatic generation system can convert images of other art forms into oil paintings, which improves the creative efficiency of red spirit posters. This system uses the current emerging non-realistic rendering technology, and uses computer image processing technology to generate paintings, which are highly personalized and artistic [4].

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2 Computer Image Processing Technology

2.1 Image Processing Technology

Computer image processing technology refers to the use of computers to generate, calculate, process and reality related principles and algorithms. Image processing technology is mainly divided into two types, namely analog image processing and digital image processing [5]. Analog image processing refers to the use of optical processing and electronic processing, such as photography, television signal processing, remote sensing image processing, etc. Analog image processing is faster and can be done in parallel at the same time, but with less precision and flexibility. Digital image processing is the use of computers or real-time hardware for processing [6]. Digital image processing has high precision, can perform complex nonlinear processing, and has strong flexibility. With the development of computer technology, the amount of information that can be processed by computers has increased, and people's requirements for image processing have become higher and higher. Therefore, digital image processing has become a very popular image processing technology. The oil painting automatic generation system constructed in this paper uses digital image processing technology [7].

2.2 Non-photorealistic Rendering Technology

Non-photorealistic rendering technology and photorealistic rendering technology are an important branch of digital image processing technology. Photorealistic rendering technology is the use of computer technology to generate realistic effects and scenes close to the real world. The non-photorealistic rendering technology emphasizes the artistry of the image, and pays more attention to the generation of art forms such as ink painting, oil painting, gouache painting, and pencil painting [8] (Fig. 1 and Table 1).

Table 1. Comparison of non-photorealistic rendering techniques and photorealistic rendering techniques.

	photorealistic rendering	non-photorealistic rendering
basic trend	Simulate the physical world	Simulate the artist's style
Evaluation method	objective	subjective
basic method	Simulate physical processes	Study artist creation, human perception simulates physical media, and simulates the creative process to extract information from 3D models
accuracy	accurate	approximate
level of detail	Same level of detail, detail information cannot be avoided	Emphasize key points
object of expression	rigid surface	more natural phenomenon

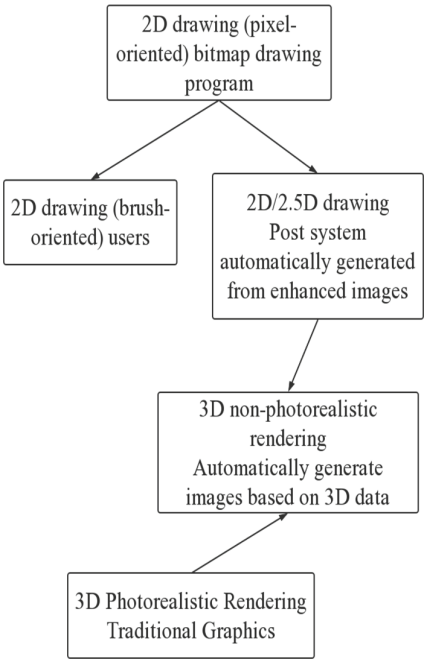

Fig. 1. The development process of non-photorealistic rendering technology

3 Automatic Generation System Framework of Oil Painting Based on Red Spirit

In this system, the initial image is firstly input. The oil painting generator will create the oil painting layer, obtain the parameter control unit, realize the parameter control, process the parameters in blocks, stages and statistics, and finally use the oil painting layer as the carrier to draw the processed image [9] (Fig. 2).

The block processing in the oil painting generation system is to process the pixels of the original image. The system divides the image pixels into squares and calculates the pixel value of the oil painting through the pixel distribution inside the squares. In the process of automatically generating the oil painting, the system draws the image in this block as a unit. The decomposition processing in the system is to classify the color of the image. The pixel color is mainly composed of R, G, and B components, and the value of each component is [0, 255]. Through the R, G, and B of different components, multi-level colors can be formed. The characteristic of oil painting is that the color is blocky, so it is necessary to reduce the color level so that it is controlled by the level parameter [10]. After performing pixel block and grading processing on the original image, the color information of the block where the pixel is located can be counted to obtain the pixel value of the oil painting. The parameter control unit will be responsible for comprehensive and effective control of the oil painting generator control parameters. The output unit of the system is responsible for storing the image drawn based on the oil painting layer [11].

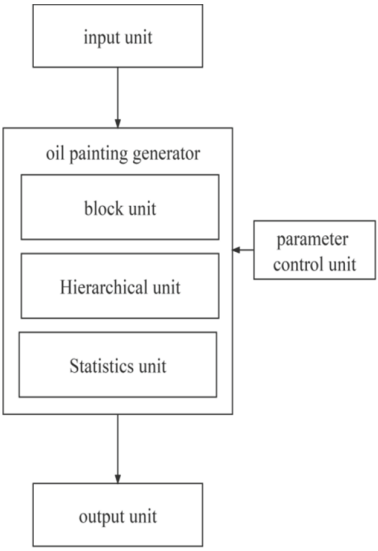

Fig. 2. Framework of oil painting generation system.

4 Oil Painting Generation Algorithm

The oil painting automatic generation algorithm first evaluates the properties of the original image. The properties of the original image refer to the sampling points from which the original image is obtained. If the original image is a color image, convert the color image to grayscale, and then get the sample points. The formula for converting a color image to a grayscale image is as follows:

$$Q_1 = 0.30R + 0.59G + 0.12B$$

Q1 in the formula represents the gray value of the gray image pixel point. R, G, and B represent the color values of the three colors of red, green, and blue in the original image.

$$Q_2 = \frac{30R + 150G + 77B + 255}{256}$$

$$Q_2 = (30R + 150G + 77B + 255) \gg 8$$

Q2 refers to the gray value of the grayscale image pixel. $>>8$ refers to moving eight bits to the right.

The algorithm uses the grid method to obtain the sampling points of the grayscale image and performs random offsets. The algorithm divides the grayscale image into multiple 7×7 pixel grids, and uses the vertices of the grid as sampling points. The algorithm will generate a random value between 1–3, and the sampling point will be shifted horizontally by three times the random value and vertically offset by the random

value. The formula for the horizontal position offset and the vertical position offset is as follows:

$$\text{Offset\_x} = 3[\text{Rand}()\%3]$$

$$\text{Offset\_y} = \text{Rand}()\%3$$

Within the formula, Offset_x is the horizontal position offset and Offset_y is the vertical position offset. Random values are enclosed in parentheses. Rand() %3 is the remainder of the random variable with 3.

Taking the gray value of the sampling point as the carrier, the algorithm will use the horizontal edge operator and the vertical edge operator to calculate the position gradient of the sampling point. The horizontal edge operator and the gray value of the sampling point are matrix-multiplied, and the result is the horizontal edge intensity. The vertical edge operator is multiplied by a matrix with the gray value of the sampling point, and the result is the vertical edge intensity. Both the horizontal edge operator and the vertical edge operator are 3 × 3 Sobel operators [12]. The formula is as follows:

$$T_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ 1 & 0 & 1 \end{bmatrix}$$

$$T_y = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

The gradient of the sampling point can be calculated by using the horizontal edge intensity and the vertical edge intensity.

The gradient of the sampling point can get the specific direction of the oil stroke. The vertical direction of the gradient of the sampling point is the direction of the stroke, and the formula is as follows:

$$\text{D} = \frac{\pi}{2} - \theta$$

θ is the gradient direction of the sampling point.

Taking the point of the sampling point as the core and the pixels in the 3 × 3 field as the window, the edge intensity of the window can be calculated by the edge operator in the 45° direction and the edge operator in the 135° direction. The formula is as follows:

$$\text{c}(\text{x}, \text{y}) = \text{C}_1 \times \text{I}(\text{x}, \text{y}) + \text{C}_2 \times \text{I}(\text{x}, \text{y})$$

$$C_1 = \begin{bmatrix} 1 & -1 & -1 \\ -1 & 4 & -1 \\ -1 & -1 & 1 \end{bmatrix}$$

$$C_2 = \begin{bmatrix} -1 & -1 & 1 \\ -1 & 4 & -1 \\ 1 & -1 & -1 \end{bmatrix}$$

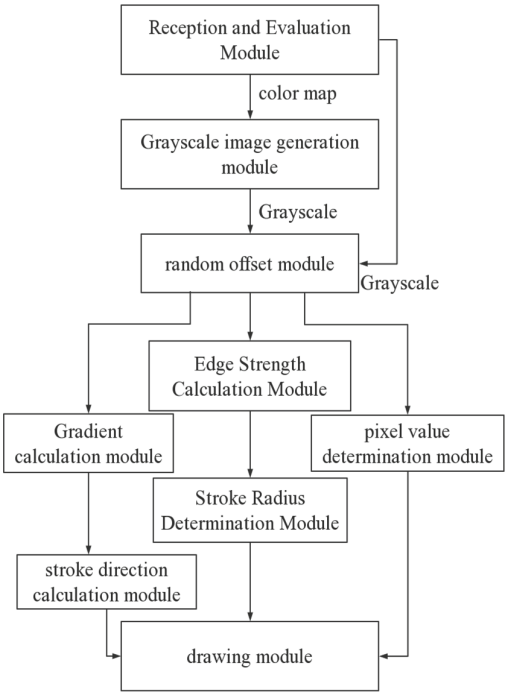

Fig. 3. Algorithm process for automatic generation of oil paintings.

C1 is an edge operator in the 45° direction. C2 is the edge operator in the 135° direction. c(x,y) is the window edge strength. I(x,y) is the window pixel point [13].

After that, the algorithm obtains the radius of the stroke through the relationship table between the edge strength and the radius calculated by the formula.

The brush pixel value of the automatically generated oil painting can be obtained by the pixel value of the corresponding position of the sampling point on the original image [14].

So far, the algorithm has calculated the stroke direction, pixel value and radius of the oil painting, and an automatically generated oil painting can be born [15] (Fig. 3).

5 Conclusion

In this paper, an automatic oil painting generation system is constructed based on computer image processing technology and non-photorealistic rendering technology. This system can process other forms of images, such as photos and color paintings, and finally form an image with the characteristics of oil painting. This system has strong practical value for the generation of publicity images. Users can input real historical pictures or other forms of red spiritual images into the system, and finally get oil painting images. At present, this research is still in the construction stage, and the system testing will begin after the system construction is completed in the next step. At present, it is in the

preliminary development stage of the system, but the application prospect of this system is very broad, and it is worthy of in-depth research and development.

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