

Research on the Application of 3D Model in Chinese Painting Real-Time Drawing System under Computer Technology

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Abstract: With the development and progress of society, people's aesthetic appreciation ability has improved and more and more people love Chinese paintings for collection or appreciation, but the current Chinese paintings are far from satisfying people's needs. Some people are inclined towards the development of a real-time Chinese painting system, but the existing real-time Chinese painting systems cannot meet the purchasing needs of the buyers in terms of the exquisiteness of the painting and the image of the scenery, so people are committed to seeking a new real-time Chinese painting system that meets their needs for Chinese painting. With the support of computer technology, 3D modelling has inspired the choice of 3D modelling technology to assist the study of real-time Chinese painting systems. This paper therefore investigates the application of 3D models in real-time Chinese painting systems with computer technology, and designs experiments to analyse the real-time Chinese painting system based on 3D models designed in this paper, and finds that the performance of the real-time Chinese painting system proposed in this paper has been substantially improved compared to the general real-time Chinese painting system. This paper has been developed with the development of the times, and the 3D model-based Chinese painting real-time drawing system proposed in this paper will be widely used.

1. Introduction

Chinese painting is characterised by the importance of brush and ink. A single sketch, either thick or light, can outline a character or a scene, and a simple brush and ink sketch can convey the emotion of the painter, which is not reflected in the general Chinese painting real-time painting system, and therefore loses its flavour. In order for the painting system to convey the unique characteristics of Chinese painting, it is necessary to further improve and refine the Chinese painting system.

Drawing systems have been studied and applied in a number of fields, and Sun Lingyun has developed a co-creative drawing system based on generative adversarial networks that allows machines and humans to collaborate in cartoon landscapes. The machine can understand both

cartoon style and semantics, as well as the spatial relationships between objects in a landscape image. The trained system receives sketches as semantic labelled map input and automatically synthesises its edge maps to stabilise the processing of various sketches. It then outputs a creative and beautiful painting with an appropriate style corresponding to the human sketch. Experiments confirm that the proposed drawing system successfully generates high-quality cartoon paintings [1]. Scalera Lorenzo presents a novel robotic system that generates watercolour paintings through a collaborative robot of degrees of freedom. After an analysis of traditional watercolours, different non-realistic rendering techniques were applied in order to beautifully transform digital images into artworks. Several algorithms aimed at processing backgrounds and details were implemented. The generated renderings were then converted into a series of trajectories replicated by the robot on paper. During this process, the artist of the control system can change the algorithm parameters and hardware variables (e.g. brush type, colour dilution, etc.) to obtain different artistic renderings [2]. Liong Size-Teng applies deep learning methods to Chinese painting for a variety of purposes, including automating the creation of a unified image library, facilitating updates of the latest data in the database, reducing the cost required for image classification and retrieval. First, a unified database is created, consisting of over a thousand images from the subject of Chinese painting. Then, several deep learning algorithms based on mathematical models are applied to examine the classification performance. In addition, by using instance segmentation techniques, salient regions representing important features can be identified [3]. Among the studies on painting systems, few have been reported on Chinese painting drawing systems.

In order to improve the quality of Chinese painting, this paper designs a real-time Chinese painting drawing system based on 3D models, and compares and analyses it with common real-time Chinese painting systems to investigate the realism, vividness, expressiveness and real time of the drawing, and finally draws a feasibility conclusion. This paper provides a reference path for the improvement and enhancement of Chinese painting drawing systems.

2. Requirement analysis and System Construction of the Chinese Painting Real-Time Drawing System

2.1 Characteristics of Chinese Painting

The most important characteristic of Chinese painting is that it is dominated by lines [4]. Point, line and surface are the basic elements of all types of painting, and line occupies a major position in ink painting. The artist collects different lines and uses variations in thickness, weight, softness and hardness to express the contours, texture, light and darkness of the object and to show the subtext of the object and the artist's feelings. The use of line has a direct impact on the quality of the work.

Chinese painting is a stylised art, and its principle of image-making is to create a real rather than a living image [5]. Chinese artists never attempt to replicate nature, whether it be a figure, flower or bird or landscape, but rather express nature through the artist's perception, meaning that Chinese painting contains both subjective and objective elements, reflecting the relationship and resonance between subject and object. This regenerative painting is both original and unoriginal. The process of emotionalisation is carried out through three units of perception, artistic processing and expression on canvas with brush and ink, with the three different levels reflecting the subjective colouring.

Another characteristic of Chinese painting is the use of brush and ink, but it is not the brush and ink itself, but an artistic technique that expresses the artist's feelings [6]. The combination of the tenacious brush and the well-absorbed Xuan paper results in an endless variety of brushes and inks in Chinese painting. Throughout the painting process, the artist's devotion to the feeling of the brush and ink is evident, the brush is quick but not rushed, the paint is relaxed but not frivolous, and real

objects are abstracted into sensual brushstrokes that express their unique colours. Chinese painting emphasises the elegance, contrast and impact of the palette, seeking beauty in simplicity and contrast. The use of colour in Chinese painting has always been of secondary importance, but it is also an important aspect of the study of Chinese painting.

2.2 Market Demand for Chinese Painting

In addition to collecting, the growing auction industry has become a powerful intermediary in the Chinese art market [7-8]. In recent years there has been increasing recognition and support for Chinese art, and a growing proportion of Chinese artworks in collections and auctions, making them highly sought after. As China's cultural industries continue to develop, the art market in China has also been formalised, systematised and continues to evolve. Under the influence of this climate, the art market for Chinese painting and drawing has continued to develop and, as an important part of traditional culture, it has become increasingly well known and well attended [9-10]. Chinese painting and calligraphy has become internationalised through international exchange, which has contributed to the further prosperity of traditional Chinese culture. With the rapid development of the market economy, internationalised markets are constantly interconnected in various ways. The art of Chinese painting and drawing is an important part of the highly national creative industry and is receiving increasing international and local attention. At this stage, the cultural industry has been integrated into the market economy, and with the rapid development of the economic base, the demand for the spiritual dimension of the cultural industry is increasing. With this economic development comes an increase in people's aesthetic awareness and ability, and an unprecedented level of luxury in artistic cultivation. Artistic talents, art critics, theorists, scholars of all kinds and art institutions have emerged. Chinese painting is gradually being valued for its long history and unique local characteristics, and artistic talents in Chinese painting are constantly emerging as a strong guarantee and driving force for the Chinese painting market, constantly pushing the Chinese painting industry to develop more systematically. As a result, the Chinese painting art market has become increasingly mature and stable, and investment in painting and calligraphy has become the investment direction of choice for many entrepreneurs. Painting and calligraphy collections are more stable than other types of investments due to their academic, historical and decorative value. Given the high demand for Chinese paintings, but the quantity and content of Chinese paintings available today falls far short of the public's needs, the public is eager for a system that enables real-time Chinese painting to be painted to meet the public's needs.

2.3 Real-time Chinese Painting System

The Chinese painting real-time drawing system is a more advanced drawing system, which can capture the line characteristics of Chinese painting in real time, and make drawings according to the complex algorithm calculation, simulating the basic characteristics of Chinese painting, the drawing system's has a strong fit and has the characteristics of real-time [11]. The 3D model not only provides a space for the application of real-time drawing of Chinese paintings, but also provides more possibilities for the development of Chinese paintings [12].

2.4 System Design

The system consists of two modules: a graphics library and a white drawing module. The graphic element library contains the graphic elements required for white drawing, which are characteristic of Chinese line drawings, taken from Chinese line drawings and processed in a specific storage format; the white drawing module allows the selection of suitable graphic elements from the

graphic element library and their use for visual editing and white drawing [13-14]. High quality printed images of the paintings are obtained from a collection of albums which are scanned on a computer using a high resolution scanning program to ensure minimal distortion of shape and colour. The composition of the system can be seen in Figure 1:

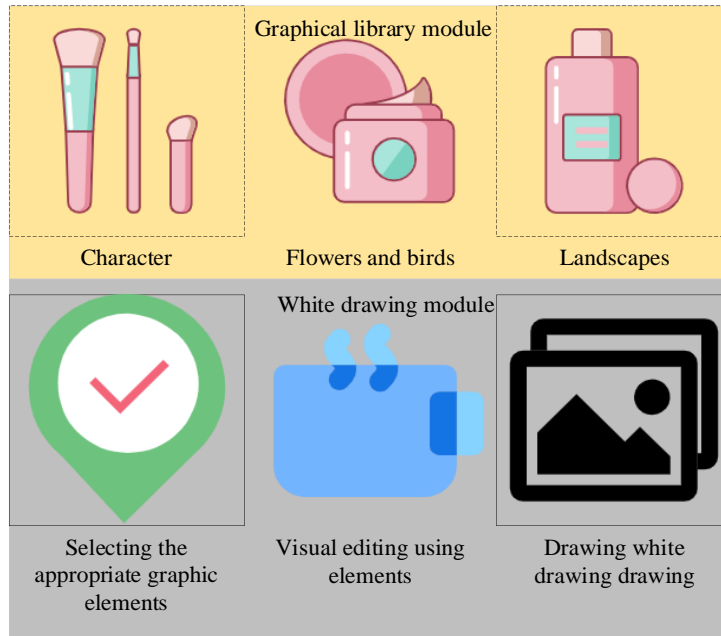


Figure 1: Composition of the system

The Bezier curve is a parametric curve based on approximation. In order to avoid the instability of the higher curves and the complexity of the calculation, this paper uses the quadratic Bezier curve as the basis for fitting and connects the lower Bezier curves according to certain continuity conditions. If the control points are given as Q_0 , Q_1 and Q_2 , the interpolation formula for each point on the Bezier curve is

$$D(t) = \sum_{x=0}^2 Q_x B_x(t) = (1-t)^2 Q_0 + 2t(1-t)Q_1 + t^2 Q_2 \quad (1)$$

Its matrix is expressed as

$$D(t) = \begin{bmatrix} t^2 & t & 1 \end{bmatrix} \begin{bmatrix} 1 & -2 & 1 \\ -2 & 2 & 0 \\ 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} Q_0 \\ Q_1 \\ Q_2 \end{bmatrix} \quad (2)$$

2.4.1 Creation and Management of a Library of Graphic Elements

The line in Chinese painting is a very common artistic language, simple and expressive, with a brilliant rhythmic beauty. Rhythm is a natural and harmonious sense of beauty that arises from the changing movement of the lines. Lineage is the foundation of Chinese painting and plays a very important role in its expression [15]. Its infinite vitality, aesthetic efficiency and expressiveness. In Chinese painting, the figure is the main object of expression, with the simple outline of the line as the modelling tool, through the thickness of the line, the length of the line, the straightness of the line, the length of the line, the lightness of the brush and ink, the sparseness of the line, the straightness of the line, the rigidity and the softness of the line. The line itself in Chinese painting has a rather independent formal beauty. Based on the above analysis, when establishing the graphic

element library, it is important to consider both the basic set of graphic elements that make up the foreground figure in Chinese painting, and the need for the graphic elements not to be too disorganised and to have a certain sense of unity as far as possible, in order to facilitate further drawing and reduce drawing time.

2.4.2 Extraction of Graphic Elements

Graphic elements are extracted by adding control points from the original drawing loaded in the Chinese painting along the outline of the graphic element to be extracted, fitting these control points with curves to obtain appropriate curves so that the collection of these curves represents the basic graphic element and adding and storing them in the graphic element library. A graphical element consists of several curves. The process of extracting graphical elements can be seen in Figure 2:

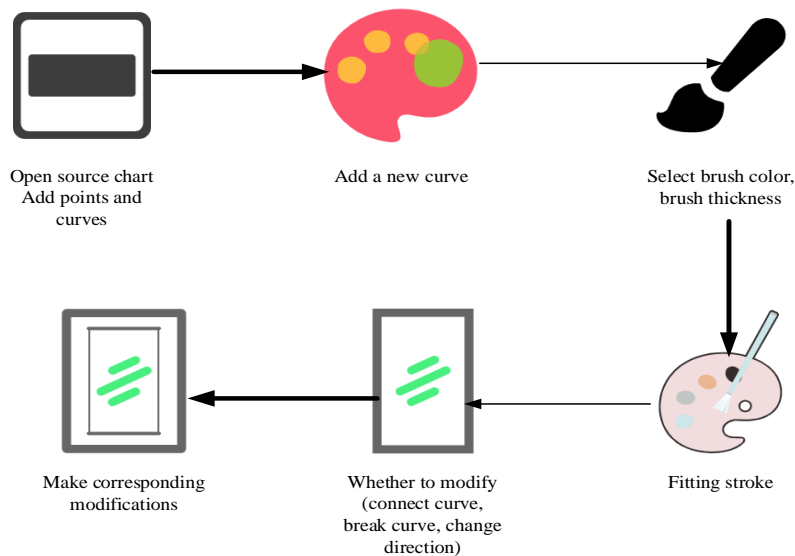


Figure 2: Extraction of graphic elements

The graphical user interface for feature extraction is divided into two parts: the left part is where the printed drawing is displayed and the right part is where the operations are performed. The area on the left shows the original Chinese drawing used to extract the graphical features. In the right-hand section the function area allows you to open the original drawing, add curves, delete curves, remove control points, select the thickness and colour of a curve, combine two curves into one, or split a curve into two. A curve is defined by a series of control points, all of which are defined with the mouse except for the first and last control point. The remaining control points are automatically interpolated according to the movement of the mouse, so if the curve is not too long and has a small curvature, it can be drawn quickly. If you want to add control points precisely, you can use the zoom function of the original image to zoom in on some of the details of the original image and add outlines for small points. Once you have all the curves that make up the drawing, you can select the category to which the drawing belongs and save it as a name in the drawing library.

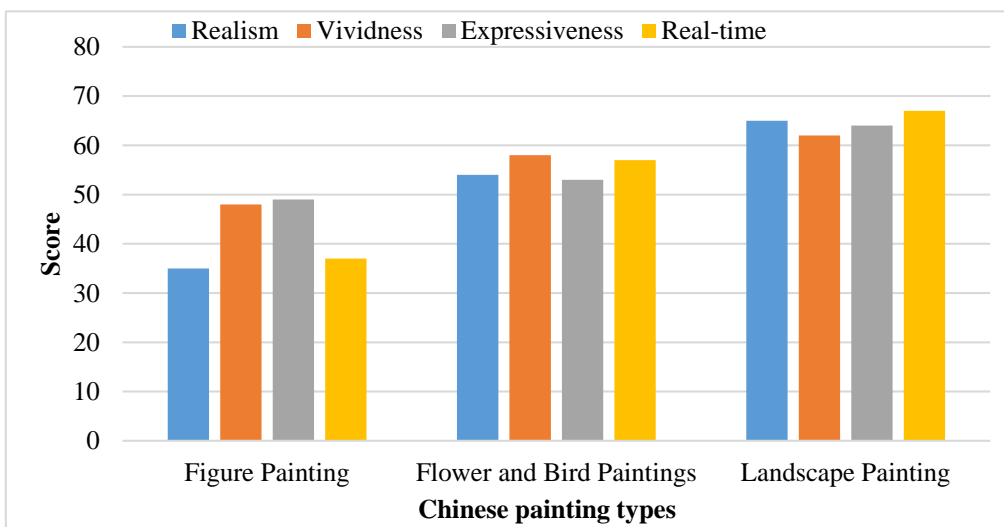
3. The Effect of the Application of 3D Models with Computer Technology

In this paper, three different types of Chinese paintings were selected: figures, birds and flowers, and landscapes, and a general real-time Chinese painting system and a real-time Chinese painting system combined with a 3D model were used to compare and analyse the basic characteristics and difficulties of the three Chinese paintings selected for the experiment and recorded in Table 1:

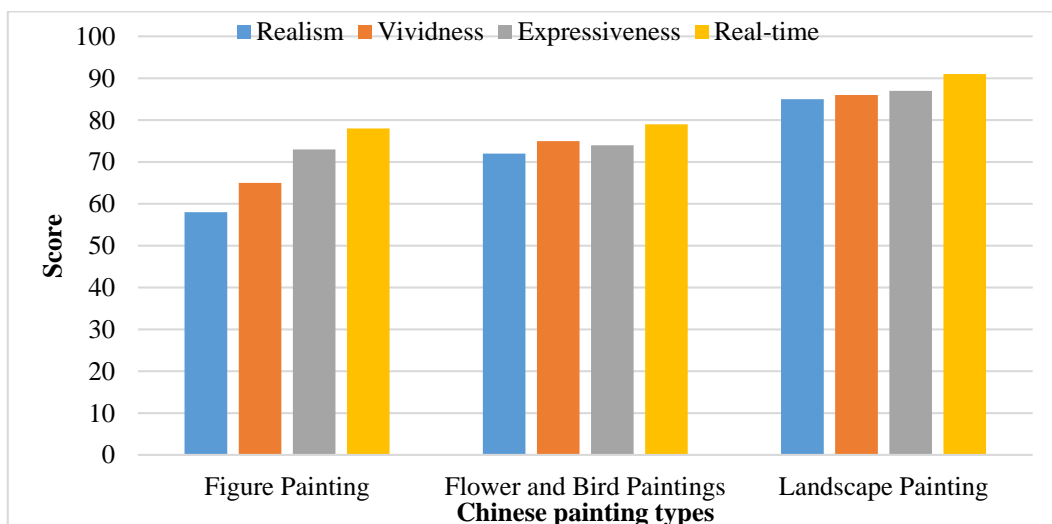
Table 1: Basic information of survey subjects

Chinese Painting Types	Characteristics	Difficulty of painting
Figure Painting	Expressions of human society, the relationship between man and man	5
Flower and Bird Paintings	Expression of the relationship between man and nature, integrating man and nature	4
Landscape Painting	Representing the various life of nature, living in harmony with human beings	3

Using a 5-point scale as the most difficult benchmark, with figure painting being more difficult than bird and flower painting and more difficult than landscape painting, the paintings of the two Chinese painting real-time drawing systems were then recorded in Figure 3:



A. General Chinese painting real-time drawing system



B. Real-time Chinese painting system combined with 3D model

Figure 3: Drawing effects of different Chinese painting real-time drawing systems

In Figure 3, A represents a general Chinese painting real-time drawing system and B represents a real-time Chinese painting system combined with a 3D model. When the general Chinese painting real-time drawing system was used to draw Chinese paintings, the realism, vividness,

expressiveness and real time performance of the three paintings were all at a low level. In summary, the use of the real-time Chinese painting system combined with the 3D model can greatly improve the real time performance of Chinese painting.

4. Conclusion

In order to improve the real time performance of the Chinese painting real time drawing system, this paper uses the 3D model to improve the Chinese painting real time drawing system, and selects three types of Chinese paintings to analyse the drawing effect, and finally concludes. The realism, vividness, expressiveness and real-time performance of the system for drawing the three paintings are substantially improved compared to the general Chinese painting real-time drawing system. In the future, the 3D model Chinese painting real-time drawing system will have great application space and potential in the market.

References

- [1] Sun, Lingyun. "SmartPaint: a co-creative drawing system based on generative adversarial networks." *Frontiers of Information Technology & Electronic Engineering* 20.12 (2019): 1644-1656.
- [2] Scalera, Lorenzo. "Watercolour robotic painting: a novel automatic system for artistic rendering." *Journal of Intelligent & Robotic Systems* 95.3 (2019): 871-886.
- [3] Liang, Sze-Teng. "Automatic traditional Chinese painting classification: A benchmarking analysis." *Computational Intelligence* 36.3 (2020): 1183-1199.
- [4] Zhao, Shichao. "An analysis of interactive technology's effect on the appreciation of traditional Chinese painting: a review of case studies." *International Journal of New Media, Technology and the Arts* 14.3 (2019): 1-12.
- [5] Chen, Shuangshuang. "Exploration of artistic creation of Chinese ink style painting based on deep learning framework and convolutional neural network model." *Soft Computing* 24.11 (2020): 7873-7884.
- [6] Zhang, Jie. "A novel automatic image segmentation method for Chinese literati paintings using multi-view fuzzy clustering technology." *Multimedia Systems* 26.1 (2020): 37-51.
- [7] Dang, R. "Chromaticity changes of inorganic pigments in traditional Chinese paintings due to narrowband spectra in four-primary white light-emitting diodes." *Journal of Optical Technology* 86.5 (2019): 310-316.
- [8] Dang, Rui. "Chromaticity changes of inorganic pigments in Chinese traditional paintings due to the illumination of frequently-used light sources in museum." *Color Research & Application* 43.4 (2018): 596-605.
- [9] Zhao, Y., and L. Xiao. "Analysis on the landsense creation of Chinese classical poetry and mountains-and-waters painting based on landsenses ecology." *International Journal of Sustainable Development & World Ecology* 27.3 (2020): 292-296.
- [10] Zhang, Ji. "A novel automatic image segmentation method for Chinese literati paintings using multi-view fuzzy clustering technology." *Multimedia Systems* 26.1 (2020): 37-51.
- [11] Huang, Lei. "Research progress on and prospects for virtual brush modeling in digital calligraphy and painting." *Frontiers of Information Technology & Electronic Engineering* 20.10 (2019): 1307-1321.
- [12] Elkhuizen, Willemijn S. "Comparison of three 3D scanning techniques for paintings, as applied to Vermeer's 'Girl with a Pearl Earring'." *Heritage Science* 7.1 (2019): 1-22.
- [13] Liang Y. *Analysis of the Integration of Chinese Painting Techniques in Watercolor Painting*. *Arts Studies and Criticism* 3.1 (2022):37-40.
- [14] Yang D, Ye X, Guo B. *Application of Multitask Joint Sparse Representation Algorithm in Chinese Painting Image Classification*. *Complexity* 2021.2 (2021): 1-11.
- [15] Jiang W, Luo X. *Research on Unsupervised Coloring Method of Chinese Painting Based on an Improved Generative Adversarial Network*. *World Scientific Research Journal* 5.11 (2019):168-176.