

# *Chinese Calligraphy and Painting Electronic Creation Software based on Computer Aided Technology*

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**Abstract:** Since the emergence of computer-aided technology, countless talented artists have been trying to use computer technology as a tool for artistic creation. But early computers were expensive and had a small amount of computation. Therefore, in that era, it was very difficult to apply computers to artistic creation. With the rapid development of computer hardware technology, even an ordinary computer has far more computing power than previous large-scale computers. This creates a lot of technical possibilities for artists to realize their dream of artistic creation through computers. Although China has a long history and splendid Chinese culture and art, and the unique charm of Chinese calligraphy has been recognized by the world with the unremitting efforts of predecessors, the research of Chinese computer art is very limited in the field of computer science. In addition, the current research on computer art in the form of western art cannot well solve many problems encountered by traditional Chinese calligraphy and art in the process of digitalization and informatization, and can provide technical support for it. On the basis of computer aided technology, this paper establishes a virtual interactive computer simulation model framework for the electronic creation of Chinese calligraphy and painting. The experimental results show that by using the interactive virtual brush model, Chinese calligraphy and painting with strong artistic expression can be produced.

## 1. Introduction

China has a long history, and Chinese culture and art are also brilliant. With the unremitting

efforts of previous generations, the unique charm of Chinese painting and calligraphy has been recognized by the world. On the other hand, with the advent of the first computer, the development of computer technology in the world has lasted for many years. However, the research of Chinese painting and calligraphy in the field of electronization started relatively late, and the attention and social impact were not enough. What is more regrettable is that the current computer technology for Chinese art cannot meet the requirements and challenges of digitalization, digitalization and informatization[1]. Chinese calligraphy art must have its own computer technology.

For the electronization of Chinese painting and calligraphy: Gao Hongchen analyzed the current teaching situation of Chinese painting and calligraphy courses from the perspective of traditional Chinese painting and modern art, discussed the value of combining the two into the art teaching in primary schools, and pointed out that Chinese painting and calligraphy are the bridge between ancient and contemporary art, and built a curriculum model that combines artistic language and discipline concepts. Hung Keung believes that China's traditional art methods can be absorbed by digital media and establish a new cross-field relationship with them. The use of digital media can transform China's concept of time and space from traditional aesthetic to modern artistic environment[2]. Huang Lei proposed that the modeling of virtual brush is the most critical part of virtual painting. The powerful virtual brush model can truly represent the real brush characteristics, and improve the realism of virtual image quality. Chinese calligraphy and painting have a long history, which is a beautiful and wonderful work in traditional Chinese art, and also a great treasure in the history of world art. How to design a set of virtual brushes that can interact with users, respond in real time and have artistic expression has always been an important topic in the field of computer graphics and interaction[3].

The effective combination of computer technology and Chinese calligraphy and painting art design is a new revolution in art. It can expand the plane and three-dimensional design space to four dimensions, break the conventional way of traditional manual painting, broaden people's aesthetic vision, and bring a strong visual impact. This is a new way of artistic creation, which can fully express the creativity and rich imagination of designers, Thus, it has promoted the reform and development of Chinese calligraphy and painting art design[4].

Based on the background of computer-aided technology, the electronic software creation of Chinese calligraphy and painting is a cognitive psychological process with both theoretical research value and practical, artistic, interesting and great challenges, so as to realize the computer intelligent calligraphy and painting creation in the paperless environment.

## **2. The Development of Electronic Chinese Painting and Calligraphy**

### **2.1. The Concept of Chinese Calligraphy and Painting**

Chinese painting and calligraphy is one of the most national characteristics of all Chinese art categories. Painters and calligraphers use China's unique brush, black ink and paper to express their understanding of the universe and life in a style of writing. The lines in Chinese painting and calligraphy works are like a beautiful melody, and are the soul of artistic expression. Because of the linear movement and spatial structure of its lines, Chinese calligraphy presents rich connotations of sometimes simple, sometimes beautiful, sometimes dignified and sometimes flexible. Chinese painting shows elegant and dazzling art with the changing lines, dry and wet ink, and thick and light ink. Chinese art pays attention to reproduction, realism and freehand brushwork. In artistic creation, it will integrate the thoughts and feelings of the aesthetic subject into the object[5].

## 2.2. Characteristics of Chinese Calligraphy and Painting

Although the use of SBR algorithm to automatically generate western painting works of different styles from the original image has a good performance, it is not suitable for the painting of Chinese painting and calligraphy, mainly because of its unique characteristics.

In terms of brushwork: Western painting uses point and face to shape the body, while in terms of brushwork, it is relatively simple. In Chinese calligraphy works, brush strokes are the main modeling method. There are two ways to express strokes: forward and backward; From the position of the stroke front in the stroke, it can be divided into center and side front; From the perspective of dryness and wetness, there are dry pens, dry pens and other "colorful ink".

The brush uses different elasticity and water absorption properties in materials, such as sheep hair, wolf hair, purple hair, etc., to produce different strokes that combine hardness and softness. This makes it very difficult to build a computer virtual rendering model. Either the rendering speed is too slow because of too much computation, or the image quality is relatively rigid[6].

Material of paper: In Western painting, except watercolor, there is no painting that pays attention to penetration. Therefore, the expression and overlap of pen and ink are relatively simple. The raw paper commonly used in Chinese calligraphy and painting is a kind of paper with strong water absorption and long fiber. Painting on raw paper will have a great penetration effect, and will also appear white, dry pen and other phenomena due to the rapid change of water, and the overlap between strokes is a very complex phenomenon.

In addition, in terms of color and ink simulation, Chinese painting pigments can be divided into plant pigments and mineral pigments, with different transparency characteristics. When expressing the overlapping effect of methods, more factors need to be considered than western painting[7].

## 2.3. Problems in the Electronization of Chinese Calligraphy and Painting

After several years of research, although the computer virtual rendering technology of Chinese calligraphy and painting has made great progress, compared with the real Chinese calligraphy works, its expression and effect still have a great distance. Because of these differences, the current computer virtual painting of Chinese calligraphy and painting still faces many new problems[8].

The performance of imitating Chinese calligraphy and painting is poor. The strokes of Chinese calligraphy are flexible and changeable. At present, there is no intelligent expression of basic strokes, such as exposed strokes, partial strokes, and side strokes, in the field of computer drawing, such as the points of flower and bird painting, and the texturing of mountains and rivers, which is also difficult to achieve[9].

Weak interaction ability. Now, people are concerned about the interaction of ink and water in a single brush stroke. In fact, the interaction between the brush strokes on rice paper, different ink and color, namely "water breaks ink" and "ink breaks water", which requires a more refined paper and pigment based on the analysis and research of different types of rice paper and traditional Chinese painting pigments. Of course, this still needs to further improve the computing ability of the hardware[10].

The input method is difficult to meet. Because the amount of information input by the mouse is very small, it is difficult to meet the needs of users. Therefore, it is also a big problem to develop a low-cost input technology that can not only adapt to the calligraphy creation habits, but also convey a large amount of fine motion information.

### 3. Concept and Application of Computer-Aided Technology

#### 3.1. Concept of Computer-Aided Technology

Computer technology refers to the theory, method and technology that uses computers as a tool to help people work in a specific application field. It mainly includes auxiliary design, manufacturing, teaching, quality control and drawing. "Assisting" emphasizes the leading role of human beings in it. It is a system of close interaction between people composed of computers and users controlled by human beings[11].

#### 3.2. Application of Computer Graphics and Image Technology

Computer technology is the integration of computer science and art. With the rapid development of computer technology, the creators of computer art must understand the basic principles and use methods of computers. It uses computers as a creative tool, transmits and sublimates information in the form of images and graphics in accordance with aesthetic principles, and has its unique characteristics, thus creating a new artistic form. The result is that, while bringing aesthetic enjoyment to mankind, it also creates a new cultural form for human society. Computer art is a new frontier discipline that combines computer technology with traditional art. According to its purpose and function, computer art can also be divided into practical art and appreciation art. In terms of its creation, there are also pure painting and practical art[12]. The so-called "pure" art, also known as "appreciation", is an art that aims at aesthetic appreciation and satisfies psychological needs such as appreciation and entertainment. It covers art forms similar to traditional oil painting, watercolor, printmaking, traditional Chinese painting, and also presents a new art form of interactivity and multimedia; Applied art design is an art design that pays attention to practicality, practicality and beauty. The application of computer image technology is shown in Figure 1, including architectural design, modeling design, clothing design, advertising design, animation design, virtual reality, and so on. It is an organic combination of computer technology and art design, and has been widely used in today's computer art design. In fact, this is also a relative distinction. Pure painting does not exclude practical goals, and the use of art is also to achieve aesthetic goals, but the focus is different.

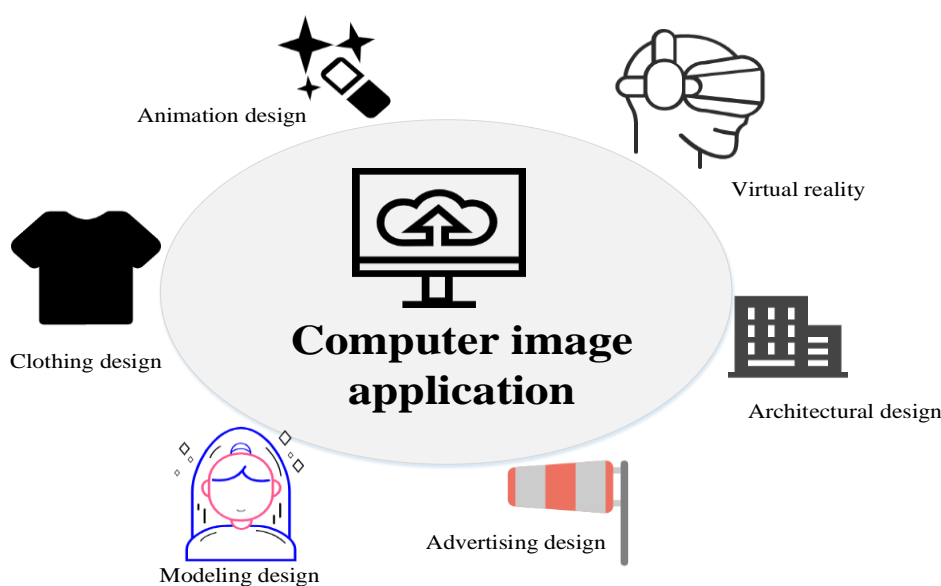


Figure 1. Application of computer graphics and image technology

### 3.3. Design Requirements for Computer Aided Art Design System

In the design of computer art design and auxiliary system, the feasibility analysis should be carried out first, and the demand analysis and function analysis should be carried out according to its actual application. Its main function is to provide technical guarantee for the design of perfect works of designers[13].

In the auxiliary design system, to ensure that the designer can freely select materials and change the selected materials at any time, there are two ways to replace and modify them, one is to use the default standard materials of the system, the other is to design manually by the designer.

The practicability of the computer aided art design system is to ensure that the designer can make the size, shape, color, etc. of the work according to the needs. The auxiliary system can be used to preview the finished product in advance and correct the unqualified or unsatisfactory parts, thus ensuring the beauty of the work[14].

The design purpose of computer art design assistance system is to enable developers to better understand and learn these works. The administrator shall manage the script information within the scope of his/her authorization, and provide free access and download for engineers to improve the development efficiency of the system.

## 4. Build the Software Framework Model of Chinese Painting and Calligraphy Electronic Creation based on Computer-Aided Technology

### 4.1. Brush Model and Rendering Method based on Computer-Aided Technology

This paper introduces a modeling model of brush virtual interactive rendering using computer-aided technology, and corrects it accurately offline. It not only ensures the picture quality, but also improves the speed.

Define an interpolation interval spline curve of Chinese calligraphy and painting, where its central curve  $D(x_i)$  is the interpolation of a series of given points  $y_i$ , namely:

Where  $x_i$  is the chord length parameter.

Where  $I_j$  is the length of  $y_i y_{i+1}$ .

This curve can be uniquely solved by solving the equation. Interval spline curve refers to a group of interval splines within a certain range of interval control points, or determined by the control graph in the control points. When the brush touches the paper, its curve becomes a circle. Every once in a while, it will record the shape of a pen tip as the control point of a curve, so as to complete the thickness change of ink lines. The design flow is shown in Figure 2

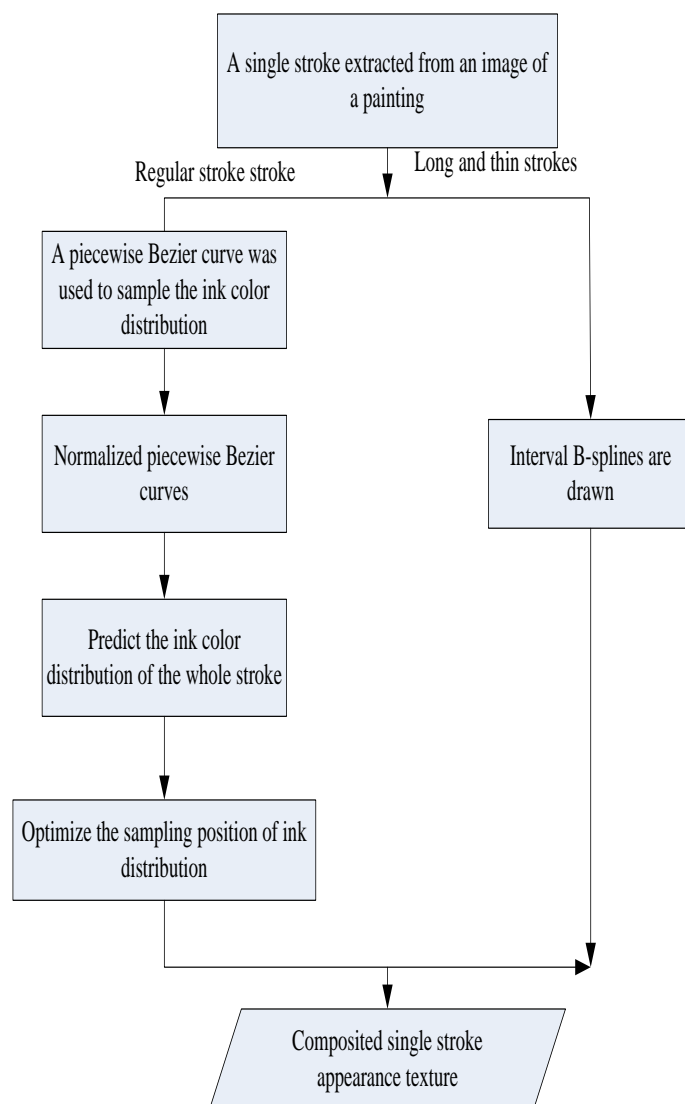


Figure 2. Algorithmic steps of the stroke analysis and synthesis process

#### 4.2. Construction of E-Book and Painting Creation Software Model based on Computer-Aided Technology

First, construct a basic drawing unit without constraints. Through the analysis of the user's action of writing and painting with a brush, it is concluded that the function of "moving the brush" is only limited to the freedom of three movements of the brush. It provides a feasible basis for the use of virtual pen and the combination of keyboard and mouse. Then, according to the user input data on the recent simulation time slices, the pen's movement inertia is calculated, and the pen's movement without external force is estimated. Then, according to the ink color, wetness and the wetness of the paper, the obtained cross section is filled with color, which is to realize the coloring of the virtual brush on the paper. In the design process, this method makes full use of the characteristics of computer-aided technology and improves the speed and real-time of the algorithm. The software model of interactive calligraphy and painting creation based on computer-aided technology is shown in Figure 3.

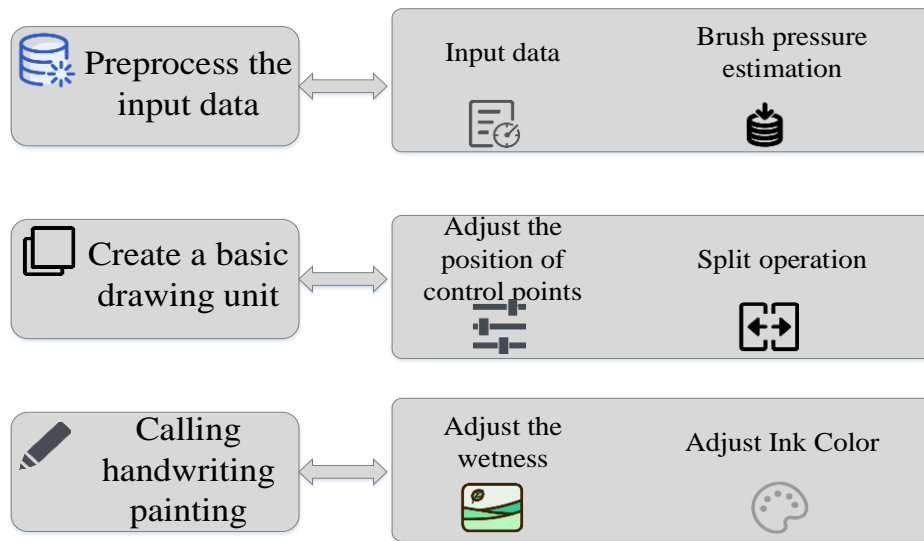


Figure 3. Interactive painting and calligraphy creation software model based on computer-aided technology

Table 1. Performance statistics of the model

NUM.	Area of stroke	#A	#A2	#A3	#A4	#A5
1	4189	3	59.28	31.28	32.31	16.32
2	13540	3	32.61	14.64	32.31	8.21
3	4362	4	31.21	21.32	32.31	10.37
4	13365	4	1.22	10.28	32.31	5.21
5	4658	5	20.31	12.06	32.31	8.21

As shown in Table 1: The "stroke area" column gives the number of pixels contained in the simulated stroke, and column #A shows the number of pigment types participating in the simulation: column #A2, column #A3, and column #A4 show the response speed of the program when the pigment behavior simulation module, the display rendering module, and the virtual brush geometry and dynamic deformation module are run separately, respectively, in the number of frames that can be updated per second. Column #A5 is the overall system response speed when all modules run together

#### 4.4. Experimental Results of Software Model for Electronic Creation of Chinese Calligraphy and Painting

To test the aesthetic degree of the electronic creation of Chinese calligraphy and painting based on computer assistance, this paper selects five electronic paintings simulated by computer to compare with the average aesthetic degree score of the original painting, as shown in Figure 4. Figure 4a is the average aesthetic degree score of five original paintings, and Figure 4b is the average aesthetic degree score of five electronic paintings. The result shows that the score of Chinese calligraphy and painting based on computer assistance is very close to the original painting score, even more, the score of individual paintings exceeds the score of the original painting. Therefore, the Chinese painting and calligraphy created with the help of computer can not only simulate the effect of hard brush painting and calligraphy, but also greatly accelerate the efficiency of virtual brush writing and painting.



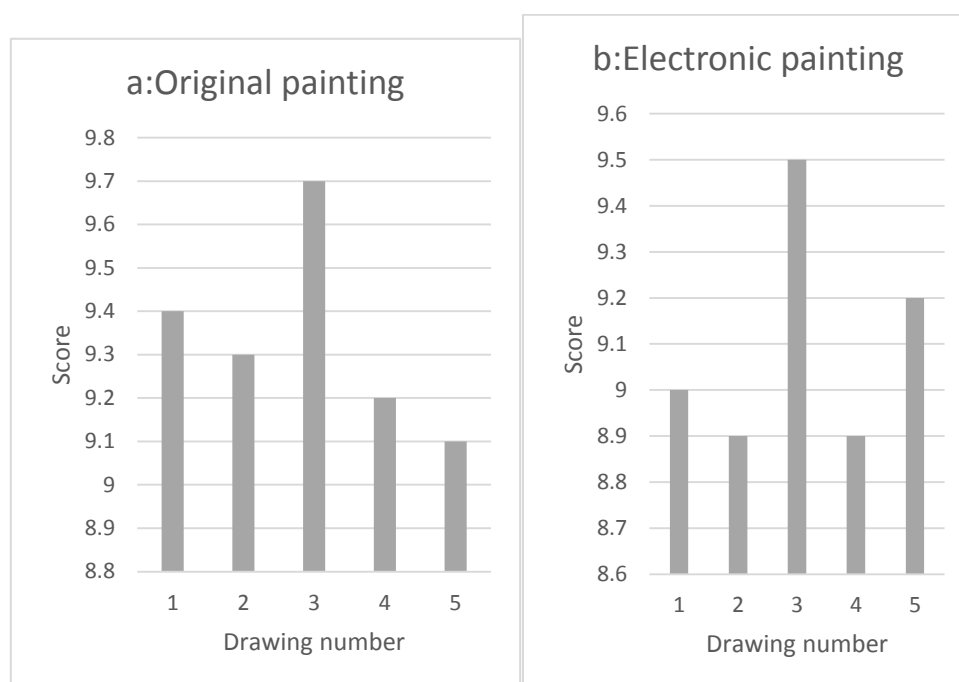


Figure 4. Compare the average aesthetic score of the electronic painting simulated by computer aided technology with that of the original painting

## 5. Summary

Computer drawing design is a new way of artistic creation, which is based on computer-aided technology and combines computer technology with design art. Art designers should not only be proficient in design software, but also have high artistic accomplishment and good art foundation. Based on computer-aided technology, this paper constructs a software model framework that can create electronic works of Chinese calligraphy and painting[15]. The research in this paper has great theoretical value and good market application prospects, and has great practical significance for the digital transformation of traditional Chinese calligraphy and painting in the information age. Compared with traditional art design methods, computer aided system has higher design efficiency. As people's requirements for art quality become higher and higher, it is necessary to continuously optimize its creativity and practicality, and analyze the technical details of the software system, further improve it, and provide assurance for designers' artistic creation.

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## Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

## Conflict of Interest

The author states that this article has no conflict of interest.



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