Design and Application of AI-based Brush Calligraphy and Painting Robot

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Abstract

With the rapid development of digital technology and artificial intelligence, the innovation and exploration of traditional painting forms in the field of digital art have become increasingly captivating. The focus of this research is to create a brush calligraphy and painting robot system based on PLT files. It digitizes user creative instructions to autonomously generate brush calligraphy and landscape paintings. This technology not only advances the deep integration of digital art and traditional culture but also opens new perspectives and vast possibilities for artistic creation.

Keywords: Artificial intelligence, Calligraphy and painting robot, Brush word, Landscape painting, Digital art

Introduction

With the rapid progress of digital technology [1] and artificial intelligence, traditional art forms [2] are experiencing a profound digital change, and brush painting and calligraphy as a precious heritage of traditional Chinese culture is no exception. This study aims to further explore the influence of digital technology on traditional painting, and explore the widespread application of this technology in the field of art creation. The core concept of the brush calligraphy and painting robot system is planted on the basis of the PLT file. It receives the user's creative instructions in a digital manner and aims to independently draws brush characters and landscape painting. The rise of artificial intelligence provides strong technical support for the design of brush calligraphy and painting robots. The algorithm of machine learning such as deep learning enables the machine system to imitate the unique brush strokes of the brush, and even understand the emotion and artistic conception expressed by the artist in landscape painting. This technology not only injects new vitality into traditional art, but also expands the boundaries of art creation, and provides users with more diversified and innovative creative methods. In this study, we will introduce the technical principles, design frameworks and application scenarios of the brush calligraphy and painting robot system. Through in -depth excavation of these aspects, we expect to provide in -depth insights for the integration of digital art and traditional culture, and contribute to the innovation and inheritance of traditional culture of digital art.

1. The main text

The design scheme uses a robotic arm, a set of linear guide systems, as well as painting tools such as pen, ink, paper, and inkstone. The robotic arm is mainly responsible for grasping the brush and realizing dipping ink, writing and painting [3]. The robotic arm is cleverly placed on the linear guide to expand its movement range and improve accuracy and efficiency [4]. For the overall design effect, see Fig. 1.

Fig.1 overall arrangement

2. Core structure of robotics

The robotic arm chooses the desktop four-axis robotic arm of Yuejiang Technology. As shown in Fig. 2, the robotic arm works radius of 320mm, the load is 0.5kg, the repeated positioning accuracy is 0.2mm, and it has high accuracy in the vertical direction. And in the horizontal direction, it can be moved quickly, with a light weight and a small volume. The length and width of the base are 158mm. You can complete the writing or painting work of this robot. The first

freedom of the robotic arm is the rotation freedom composed of a shaft base. The second and third degree of freedom is the rotation freedom composed of large arms and small arms. Four freedom is located at the end of the robotic arm, which is rotating freedom [5]. You can install a fixture or suction cup at this location. The robot chooses a fixture to pinch the brush.

Fig. 2 Manipulator

The core parameters are shown in Table 1.

Table 1. The core parameters of the robotic arm.

Weight	3.4 kg
Base Dimension (Footprint)	158 mm x 158 mm
Materials	Aluminum Alloy 6061, ABS Engineering Plastic
Controller	Dobot Integrated Controller
Robot Mounting	Desktop
Number of Axes	4
Packing Size (L X w X H)	421 mm x 334 mm x 352 mm
Payload	500g
Max.Reach	320mm
Position Repeatability	0.2mm
Communication	USB\WIFI*\Bluetooth*
Power Supply	100-240 V,50/60 Hz
Power In	12V/6.5 A DC

3. The innovation point

The convolutional neural network (CNN) [6] is usually used in tasks such as image recognition and feature extraction, and the PLT file is a format for describing the graphic drawing instruction sequence. In the design of the brush calligraphy and painting robot, the two can be used with each other.

First, convolutional neural networks can be used to generate training of PLT files. The robot can draw a specific pattern or imitate a certain style. It can use convolutional neural networks to train images, and then use the characteristics to generate the corresponding PLT files. CNN can help identify the characteristics of strokes, lines, and shapes in the image, thereby generating the corresponding drawing instructions. Fig. 3-1 is the "chrysanthemum picture" entered by the user, Fig. 3-2 is the picture form in the PLT file generated after program processing.

Fig. 3-1 Original Picture

Fig. 3-2 Processed pictures

Secondly, convolutional neural networks can be used for image recognition and PLT file generation. When the robot receives the image input provided by the user, the convolutional neural network can be used for image recognition and identify the content and characteristics of the image [7]. Then, the corresponding PLT file is generated according to the recognition result, so as to guide the robot to complete the drawing task. Fig. 4 is the calligraphy of the robot

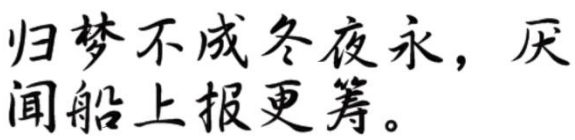

Fig. 4 the calligraphy

3.1. The use of PLT files

The PLT file provides a digital approach for describing painting instructions. By using PLT files, you can digitize traditional paintings and landscape painting such as landscape painting to make it meet the needs of modern digital art.

The PLT format is a vector graphic format, also known as HPGL (Hewlett Packard Graphics Language) format. It is a drawing language developed by HP, which was originally used to control the output of the drawer. This format is now widely used in fields such as drawing, engineering and manufacturing.

The PLT file is a text file that can use any text editor to open the viewing and editing. It contains drawing commands and coordinates, which can be drawn through these commands.

3.2. Convolutional neural network

Convolutional neural network (CNN) is a feeding neural network structure that is designed to process large image data and performs well in the fields of image and voice recognition. The network structure consists of one or more convolutional layers, full connection layers, pooling layers, and linear rectifier layers. It has the ability to capture the two -dimensional structure of the input data, especially in the field of image processing.The components of convolutional neural networks include:

(1) Convoiced layer: The convolutional layer can generate a set of parallel feature maps, and performs operations by sliding the convolution nuclear on the input image. The convolution nucleus and the input image perform the computing of the component of the element and the computing of the element. This process is called the rod. The size of the convolution nucleus is small. Enter the image through overlapping or parallel effects to share the same weight and bias item to effectively extract image features.

(2) Linear rectifier: Linear rectifier uses linear rectifier (RELU) as an incentive function to enhance the non -linear characteristics of the entire neural network without changing the output of the convolution layer.

(3) Pondalization layer: Pondization is a non -linear form of downgrade, of which the largest pooling is a common form. This layer divides the input image into a rectangular area, outputs the maximum value of each sub -area to achieve the purpose of reducing the data dimension.

(4) Complete connection layer: After the convolution and pooling layer, the neural network is high -level reasoning through the complete connection layer. The neurons in the complete connection layer are connected to all the activation in the previous layer, and activation is calculated through imitation transformation, including the addition of matrix multiplication and bias items.

4. Conclusion

This research focuses on the design and development of a brush calligraphy and painting robot system based on PLT files. By digitizing user creative instructions, the system autonomously generates brush calligraphy and landscape paintings. The rise of artificial intelligence and convolutional neural networks provides robust support for the robot's design, enabling it to mimic unique brush strokes and comprehend the emotions expressed by artists in landscape paintings. This technology not only deepens the integration of digital art and traditional culture but also explores new avenues and vast possibilities for artistic creation.

5. Future outlook

The design and application of brush calligraphy and painting robots have opened a new era of deep integration of digital art and traditional culture. In the future, the development of brush calligraphy and painting robots will inject new vitality into the field of digital art, while promoting traditional culture in the digital age. The continuous evolution of this technology will bring more possibilities to artists, educators, and cultural and creative industries, and bring a more colorful future to our art world.

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