Computer Life
ISSN: 1819-4818 | Vol. 12, No. 1, 2024

Accurate spray paint design of reciprocating machine based on binocular stereo vision

Hao Li, Shugang Liu, Shuang Liu, Yuxin Shen, Hanlin Yang

School of Computer Science, North China Electric Power University, Baoding 071003, China

Abstract: There are many problems in the positioning and quality control of the traditional reciprocating paint spraying system, which seriously affect the quality and production efficiency of the paint spraying system. Because of the mechanical structure to determine the position, it is difficult to realize high-precision positioning environment illumination conditions will increase the position error of the positioning system. Therefore, we need to adopt new technologies to improve precision to solve these problems. Our team used the binocular camera and the computational science OpenCV depth recognition algorithm to realize accurate identification, built a painting model of the reciprocating machine, and designed a precise painting system based on binocular stereo vision.

Keywords: Computer vision, binocular camera, Opencv, reciprocating machine.

1. Introduction

The precision painting design of reciprocating machine based on binocular stereo vision utilizes Intel D435i camera system and realizes algorithm control through Opencv. The main purpose is to improve the painting efficiency of reciprocating machine and save the use of paint to a certain extent. We proceed from the actual demand, use advanced computational science to solve the practical problems, and realize the combination of new technology and old technology. As an interdisciplinary subject, computational science uses computers to analyze and understand digital images or video sequences, and is widely used in self-driving, medical image analysis, face recognition and other fields[1]. With the wide application of deep learning in the field of computational science, computational science technology has been greatly developed.With the rapid development of computational science technology, a powerful and open-source computational science library is needed to support the development and application of computational science algorithms. OpenCV is the open-source computational science library that meets this need. OpenCV contains a large number of mature computational science algorithms and function interfaces, and implements many basic algorithms such as image processing, feature extraction and matching, object detection and recognition[2].

2. Research Status and Significance of Accurate Paint Spraying Design for Reciprocating Machine Based on Binocular Stereo Vision

At present, the existing paint spraying reciprocating machine in the factory will waste a lot of paint in the process of operation, on the one hand, increase the cost of the factory, on the other hand, waste a lot of paint, and have a great impact on the environment. Moreover, the technology used in the paint reciprocating machine is relatively backward, and compared with other advanced paint spraying equipment, its operating efficiency and paint utilization rate are very low. It is necessary to develop a reciprocating machine that saves paint, so that the factory can save a lot of paint and get a higher profit. With the rapid development of computer technology, the intelligentization of equipment in factories is unstoppable. As the subject of knowledge innovation, colleges and universities need to proceed from reality, solve practical problems with advanced technology, adapt to modern needs, and promote scientific and standardized production.

Ultimately, we hope to achieve the following objectives through this system: is beneficial to improving the paint spraying efficiency of the paint spraying reciprocating machine and saving the use of paint without reducing the paint spraying efficiency. is beneficial to solving the harm caused by paint pollution to air quality.Use less paint, develop low carbon life, achieve cost-saving effect, improve the working environment of employees.

3. System introduction

3.1. Requirement analysis

With the rapid development of the information age, the demand of various electronic components is increasing day by day, and the production efficiency of factories is also in urgent need of improvement. The traditional paint reciprocating machine has a high paint loss rate during operation, and the need for a paint reciprocating machine that saves paint usage is indispensable. If the paint reciprocator in the factory was upgraded to our computer vision-powered reciprocator, its productivity and paint savings would be significantly higher, and its economic benefits would be significantly higher.Because the color and shape of the sprayed objects are not fixed, it is difficult to identify objects with different shapes and colors. The precision spray painting technology is inseparable from the depth vision technology. In this project, Intel advanced binocular camera D435i is used to upgrade and optimize the traditional painting reciprocator. Opencv, an open-source computational science library, is used to support the algorithm.

3.2. System working principle

Figure 1 shows the working principle of the system.The depth recognition algorithm in this paper is mainly based on threshold segmentation of OpenCV. Threshold segmentation is an image segmentation method based on pixel gray values. It compares the image based on pixel gray values with preset threshold values and divides the pixels into different regions or categories. Threshold segmentation is often used in image processing and computer vision, such as object extraction and edge detection. The basic idea of threshold segmentation is to select an appropriate threshold value and divide pixels into two categories: Pixels below the threshold are classified into one category, and those above the threshold are classified into another category. Threshold segmentation is a simple and common method for image segmentation, but it has some limitations for complex images and noises. In practical applications, other image processing techniques and algorithms, such as edge detection region growth, can be combined to improve the accuracy and robustness of segmentation.

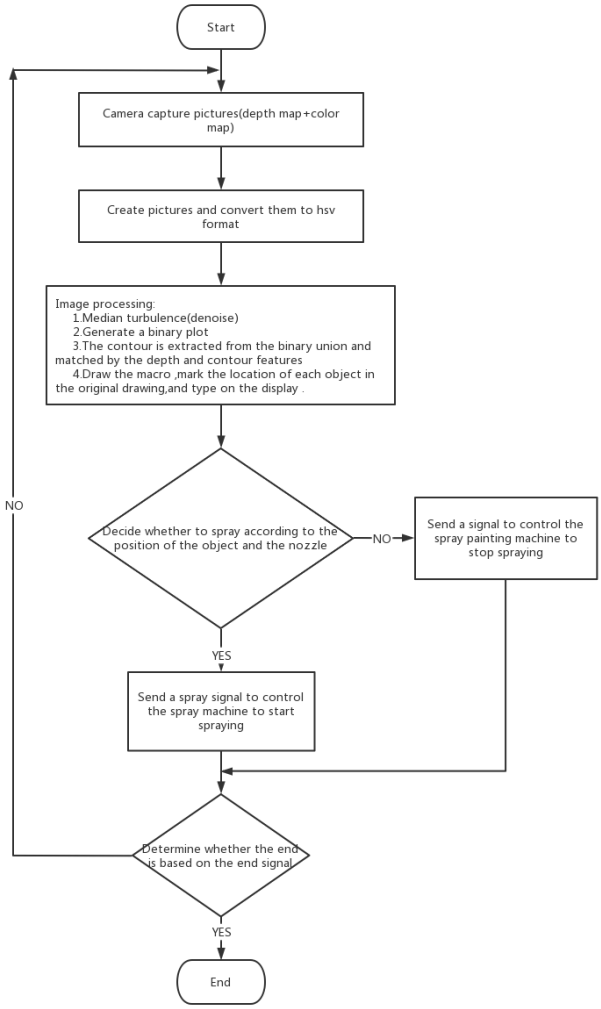

Figure 1 System schematic

First, we import relevant computer vision libraries, such as RealSense Camera, 0penCV Library, and pyautogui Library, which lay the foundation for the algorithm. The system initializes the Rea1Sense device using the pyramidalsense2 library and configures the parameters of the depth and RGB data streams precisely to ensure high quality image input. After acquiring the image source, it does a precise alignment of the depth map and RGB map. At the same time, the depth map is restored by color, which is convenient for subsequent visual extraction. The system also carries on format conversion and other preprocessing to RGB image to adapt to the needs of the subsequent algorithm.Based on this, it designs a whole set of core algorithm flow of object detection. The images are first read in, the color and depth data are converted into a matrix, and then the gbr is converted into an hsv mode that the computer can process. Then a series of treatments are performed on the matrix: The median filter reduces the noise of the picture, generates a binary map through open operation, then extracts the outline of the object from the binary map, determines the position of the object by combining the information of size and shape, and extracts the coordinate position and size information of the object.The identification results of the worktable, the object to be sprayed and the spray nozzle of the paint spraying machine are formed on the display screen. finally, judging whether spray is sprayed or not, according to the position and size of the spray head and the object, when the object and the spray head are overlapped, the spray head is switched on, otherwise the spray head is closed. The process of continuous circulation is repeated to realize accurate spraying of the reciprocating machine.

The system successfully extracted and marked the precise position of several objects such as nozzle, workbench and object to be sprayed by depth and profile. In addition, it also calculates the position relation between the spray head and the covered area, and judges whether the two areas overlap. Therefore, an intelligent painting judging model based on the coincidence degree of the target area is designed. Finally, the system completes the closed-loop multi-target detection task by cyclically acquiring new image sources and displaying the results in real time. At the same time, the user interaction interface is provided. If ESC is pressed, the window will be closed and the loop will exit.

4. System test

The precision painting design of reciprocating machine based on binocular stereo vision is tested by actual operation. Through the problems occurred in the process of the reciprocating machine, the algorithm parameters are adjusted, and the precision painting process is also completely realized.

References

[1] LIU X W. Development and Application of the Computer Vision Technology; proceedings of the 3rd International Conference on Management Innovation and Business Innovation (ICMIBI 2016), Manila, PHILIPPINES, F Jun 01-02, 2016 [C]. 2016.

[2] Lü C H, WANG X, SHEN Y H. A Stereo Vision Measurement System Based on OpenCV; proceedings of the 6th International Congress on Image and Signal Processing (CISP), Hangzhou, PEOPLES R CHINA, F Dec 16-18, 2013 [C]. 2013.