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Design and Implementation of Gesture Recognition Manipulator Control System

Kui Xue[1], Xin Liu[2] and Jiatong Chen[3]

[1] *Hebei University of Technology, Tianjin, 300401, China*
[2] *Institute of Technology, Tibet University, Tibet, Lhasa, 850000, China*
[3] *College of Aeroengine, Shenyang Aerospace University, Liaoning, Shenyang, 110136, China*

ABSTRACT. *With the rapid development of information technology, robot technology has matured and is widely used in military, industrial, agricultural, medical, scientific research and other fields, covering all aspects of people's lives. Remote control robots can replace humans in the harsh environment, so the development potential is huge. This paper designed a robotic arm control system built on a mobile platform. Using the Leap Motion infrared gesture sensor for real-time hand motion acquisition, the computer's PC software Processing captures the gestures by calling the relevant library functions, and transmits the data to the Arduino control via WiFi. The board, thereby achieving gesture control of the robot arm. The robotic arm is built on a mobile cart with a camera remotely controlled by an Android phone, enabling a variety of remote capture tasks. The experimental results show that the gesture control robot based on mobile platform has flexible movement, convenient control and wide application fields.*

KEYWORDS: *robotic arm, PC software, gesture recognition, mobile platform*

1. Introduction

The somatosensory control robot uses the somatosensory device to capture motion and convert the motion information into the control signal of the robot. The interaction mode is more flexible and natural. The system combines the above two control methods, and writes an APP program on the Android mobile phone to realize the wireless control of the moving direction of the trolley. At the same time, the Leap Motion gesture sensor is used to transmit the data of the hand movement to the PC and processed by the Processing software. After that, it is wirelessly transmitted to the lower computer to achieve the effect of real-time control of the robot arm.

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2. System overall structure

The system uses a Leap Motion sensor that uses an infrared sensor to capture the user's hand movement trajectory and posture. Pro-cessing on the PC calls the Leap Motion library for analysis of hand coordinates and motion frames, converts them into control commands, passes them over the Arduino via WiFi, and controls the servos on the robotic arm. The robotic arm is mounted on a self-made four-wheeled mobile cart with a camera that is remotely controlled by the APP to capture tasks from a distance.

3. Software design and implementation

3.1 Robotic gesture control

The robot arm gesture recognition control uses the development kit kit for Windows environment provided by Leap Motion official website: SDK file, Leap Motion driver (version number 3.2.0). The upper computer uses the interactive graphics programming software Processing (version 3.3.5, the Java language environment is selected). The PC software Processing uses the Leap Motion library function de.voidplus.leapmotion and the Ethernet function processing.net* in the Leap Mo-tion SDK development kit for gesture data acquisition and gesture control data wireless transmission.

In Processing, you only need to read the 5 data of the hand: the coordinate value of the palm's palm point on the x-axis, the coordinate value of the palm's palm point on the y-axis, and the coordinate of the palm's palm point on the z-axis. The value, the angle of the clockwise rotation of the wrist bone point, the distance between the fingertips of the thumb and the fingertips of the index finger.

3.2 Mobile phone control of the car

The system uses the Android SDK in the Eclipse software to write a simple mobile app that controls the movement of the car. Each time a button is pressed, a corresponding control character is sent via WiFi. The control character 'a' is transmitted via WiFi to the Arduino (I) control panel. The Arduino (I) control panel calls the corresponding forward function according to the received character 'a' to realize the forward movement of the trolley. When the finger is released from any button, the phone will send the character 'l' that controls the car to stop, so that the car stops. The forward and stop procedures are shown in Figure 1.

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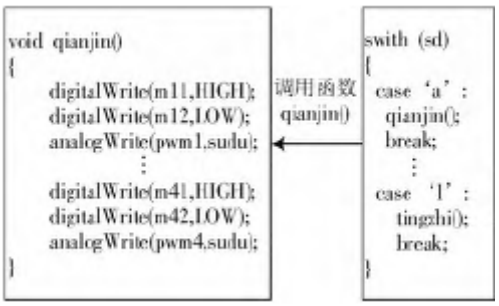

Figure. 1 Arduino end car forward and stop procedures

4. Experimental results

The experiment was completed by a Windows 7 system computer, an Android phone, and a car equipped with two Arduino control boards. The specific process of the experiment was:

1) On the Android mobile phone app, press the control button of the car, the corresponding character command will be sent to the Arduino (I) control board via WiFi, and then the corresponding direction control function will be called to realize the direction control of the car. At the same time, the camera will transmit the image information to the receiver without interruption, and detect the situation in front.

2) On the Leap Motion gesture sensor, after the hand moves, the information of the hand movement is converted into the corresponding range of the steering angle of the steering gear by the processing of the upper computer, as shown in Figure 2. Then, it is sent to the Arduino(II) control board via WiFi to control the corresponding servos, thus realizing the control of the robot arm.

Figure. 2 Gesture control experiment diagram

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5. Conclusion

This paper proposes a novel control method for the robot arm based on the mobile trolley platform: the mobile APP controls the movement of the trolley, and the gesture control five-degree-of-freedom steering gear robot arm. The experiment cost is low, the control is flexible and convenient, and it can reach a more dangerous environment and complete remote tasks. It has good application prospects in military investigation, education and scientific research, medical research and other fields.

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