Intelligent face recognition system based on OpenMV

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Abstract: With the rapid development of e-commerce in Internet technology, online shopping has become the mainstream shopping method accepted and favored by people. E-commerce and online shopping not only bring convenience to people's life, but also aggravate the surge of express delivery. In order to improve the pick-up efficiency, this paper designs an intelligent pick-up express system based on OpenMV face recognition. The system takes STM32 single chip microcomputer as the core controller, and reads and transmits express information based on OpenMV face recognition; The trolley tracks and avoids obstacles independently, and takes parts according to the planned path of the system. Experiments show that the system can realize express automatic pick-up, and has a broad application prospect.

1. Introduction

To solve express logistics problems, this paper designs an intelligent pick-up express system based on OpenMV. The whole system is a closed-loop control system based on single chip microcomputer. Firstly, face is detected through OpenMV visual recognition module and LBP feature extraction algorithm to complete face feature recognition\textsuperscript{[1]}; Identify the tracing route by setting the lab color threshold; Through PID algorithm, the car is controlled to track accurately; The steering gear rotation angle is controlled by controlling the PWM pulse width to realize the grab Express function; Through SPI protocol connection, quickly locate express information, and finally realize express intelligent access\textsuperscript{[2]}. As shown in Figure 1, the system diagram of face recognition intelligent express delivery system based on OpenMV is shown;
2. Hardware design

2.1. Single chip microcomputer minimum system
The system adopts an on-board robot controlled by STM32-1 single chip microcomputer, which integrates OpenMV machine vision module, power supply module, drive module and steering gear module. STM32-2 single chip microcomputer integrates rf card module and reading module, and transmits information to arduino-1 through wireless serial port. In principle, the system uses two 18650 lithium batteries for power supply, and the total voltage is greater than 5V. It can convert the voltage to 5V and 3.3V through the step-down chip to supply power for each module and single chip microcomputer respectively, which is driven by dc motor.
2.2. Hardware selection

2.2.1. OpenMV camera
The system selects OpenMV machine vision processing module\textsuperscript{3}. OpenMV is a small, low-power and low-cost circuit board and a programmable vision module. It can easily complete the use of machine vision through OpenMV IDE, which is very suitable for the camera of normal image acquisition.

2.2.2. DOF Manipulator
The intelligent express system selects a 6-dof manipulator. Its power system is composed of 6 servo motors, which can realize the front and rear, up and down, left and right grasping of the manipulator\textsuperscript{4}. It selects a digital steering gear with large torque, each steering gear controls a degree of freedom, and the steering joint adopts imported bearings, which can not only make the steering more flexible, but also make the steering of the steering gear at the same center.
2.2.3. Crawler driven trolley
The crawler driven trolley is adopted, which has the advantages of strong bearing capacity, low noise, stable performance and convenient operation[5]. Combined with the actual situation, the crawler driven trolley is selected, as shown in Figure 6;

3. Software design and process

3.1. Face input recognition
Face recognition adopts LBP algorithm. LBP (local binary pattern) is simply an operator used to describe the local texture features of an image. The definition of traditional LBP Operator usually refers to a 3 * 3 window, which is used as the threshold of the whole pixel. In the actual operation process, the gray values of 8 adjacent pixels are often compared with each other. If the surrounding pixels are larger than the middle pixels, the position of the pixel is marked as 1, otherwise it is marked as 0. In this way, eight pixels will form 8-bit binary after corresponding comparison, and then their pixels will be effectively weighted according to 2^p. Finally, the texture information in the region can be reflected by the value of LBP in the center of the window [6].

After traversing each pixel of the image to be recognized, all LBP coding values on the image can be obtained, and then the obtained traversal data can be transformed by histogram feature vector, and finally the distance between LBP features can be calculated [7].

Detect faces by calling the functions in the OpenMV open source vision library.

3.2. Trolley tracing
The OpenMV internal color block search algorithm uses the lab color model[8]. Through the OpenMV ide software, the image can be displayed in real time and the lab threshold of the image can be calculated. The user can select the target color by changing the threshold, and the PID algorithm is used to control the car tracking. As shown in Figure 7, it is the tracing diagram of the trolley;
4. System test and analysis

4.1 Face recognition test
The whole image library saves the face images of 10 people. Each person collects 20 photos from different angles. Each person tests 10 times to obtain the error times and correct times, and the correct rate.

Table 1 Face test table

| Full name | Number of tests | Number of errors | Correct times | Success rate |
|-----------|-----------------|------------------|---------------|--------------|
| One       | 10              | 1                | 9             | 90%          |
| two       | 10              | 0                | 10            | 100%         |
| three     | 10              | 0                | 10            | 100%         |
| Four      | 10              | 1                | 9             | 90%          |
| Five      | 10              | 1                | 9             | 90%          |
| Six       | 10              | 0                | 9             | 90%          |
| Seven     | 10              | 2                | 8             | 80%          |
| Eight     | 10              | 0                | 10            | 100%         |
| Nine      | 10              | 0                | 10            | 100%         |
| Ten       | 10              | 1                | 9             | 90%          |

The total correct rate is 93%, which is very feasible.

4.2 Trolley tracing test
The trolley tracks and grabs the express according to the specified route. The whole process does not yaw and can accurately grab the express. Finally, the test results show that the trolley power supply can work continuously for about 30 times and yaw twice in the whole process. After investigation, the reason is that the camera is not reliable and the route cannot be photographed due to the change of position. The camera position is reinforced. After testing, the overall performance is stable and good.

5. Conclusion
The system design is based on OpenMV visual recognition module and completes face feature recognition through LBP feature extraction algorithm; Identify the tracing route by setting the lab color threshold; Through PID algorithm, the car is controlled to track accurately; The steering gear rotation angle is controlled by controlling the PWM pulse width to realize the grab Express function; Through SPI protocol connection, quickly locate express information, and finally realize express intelligent access. The successful development of the system can realize the 24-hour unattended operation of the express station, which is convenient for people to take the express at any time. The system has the advantages of high accuracy, convenience, good privacy and low cost.

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