A Design of Intelligent Handling Robot Based on AT89C52

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Abstract

At present, manual logistics handling is inefficient and limited, manual operation is not only difficult to manage and maintain, but also has certain security risks in the handling process. This paper presents a logistics handling robot based on AT89C52 single chip microcomputer. The integration of the power module, sensor, and drive motor module enables automatic obstacle avoidance and information collection. The incorporation of an ultrasonic obstacle avoidance module and an infrared tracking module enhances the capability for obstacle avoidance and path searching, and can easily cope with different workplace. Handling robot arm structure reference Yaskawa MPL manipulator,the Yaskawa MPL manipulator is highly suitable for high-speed and high-precision palletizing, picking, packaging, and other industries.

Keywords: logistics handling; robot; MCU; modularization; obstacle avoidance

1. Introduction

With the rapid development and application of technology in the 21st century, the logistics transportation and handling industry has also ushered in great changes and development. Manual handling in the logistics production line has many years of history, however, the traditional manual handling has many shortcomings, such as large physical consumption, low degree of automation, low efficiency, environmental impact and so on. Nowadays, many domestic logistics enterprises still use a lot of physical handling and manual operation in the daily logistics handling operation. This situation in the current logistics industry can no longer adapt to the development needs of the market.

Although manual logistics handling still plays an important role in reality, it also faces some status quo and drawbacks, including human resource dependence, the influence of human factors, low efficiency and rising labor costs. Therefore, the use of handling robots can improve the efficiency of logistics handling, reduce costs, improve safety, and provide greater flexibility and adaptability. With the continuous development of technology, handling robots will play an increasingly important role in the logistics industry.

However, the current handling robot still has some shortcomings and still faces certain difficulties in the complex and dynamic environment. For example, objects of different shapes and sizes, different types of ground, and the presence of people and other robots can have an impact on the robot's operation and navigation. The accuracy and flexibility of handling robots still need to be improved. This paper proposes the design of logistics handling robot based on AT89C52 single chip microcomputer, and optimizes the current handling robot on the system to realize the autonomous tracking of the handling robot, avoid obstacles and complete the automatic picking of objects by the robot arm, so as to achieve the purpose of more efficient and safe logistics handling.

The rest of this article is organized as follows.The second part of the design of the robot, first introduces the system design of the robot, and then introduces the design of the drive module and the robot arm according to the system design. The third part is hardware design, which introduces the main hardware used by the robot. The fourth part of the module test, mainly ultrasonic obstacle avoidance module and infrared tracking module for testing, data analysis. The fifth part summarizes the main content of this paper.

2. Design of Handling Robot

2.1. Robot system design

The design of this paper is based on the modular design of AT89C52 microcontroller. The functions of the whole design system are divided into power module, motor drive module, ultrasonic obstacle avoidance module, infrared tracking module and robot arm module. The control of the robot arm is achieved through a vision sensor, through which information about the desired object is obtained [1]. The System composition diagram is shown in Fig. 1.

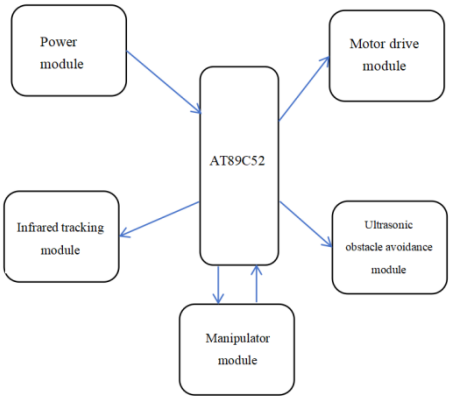

Fig.1 The system composition diagram

2.2. Drive module design

The whole work flow of the handling robot starts from the designated starting work area and gets the route information through the road condition feedback, so as to reach the designated area in accordance with the set route to complete the corresponding work. Therefore, the design of the driving module of the robot in this paper needs an automatic tracking system to realize. The automatic tracking system flow is shown in Fig. 2.

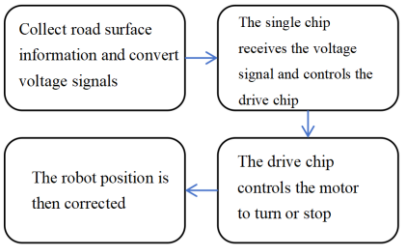

Fig. 2 The automatic tracking system flow

The infrared tracking module uses the TCRT5000 infrared sensor as the path detection sensor to realize the detection of the road track route [2].

2.3. Robot arm design

Mechanical arm structure reference Yaskawa MPL series mechanical arm, Yaskawa MPL series mechanical arm structure is simple, fewer parts, parts of low failure rate, reliable performance, simple maintenance and maintenance, less inventory parts required. The MPL structure has high control performance and precision, can meet the complex motion control needs, and can be flexibly configured and expanded to adapt to different application scenarios and requirements.

The Yaskawa MPL manipulator has a modular design, and individual joints and components can be installed and replaced independently. This design makes repair and maintenance easier and faster, reducing downtime and repair costs. The Yaskawa MPL0100 robot arm model and fixture model is shown in Fig. 3.

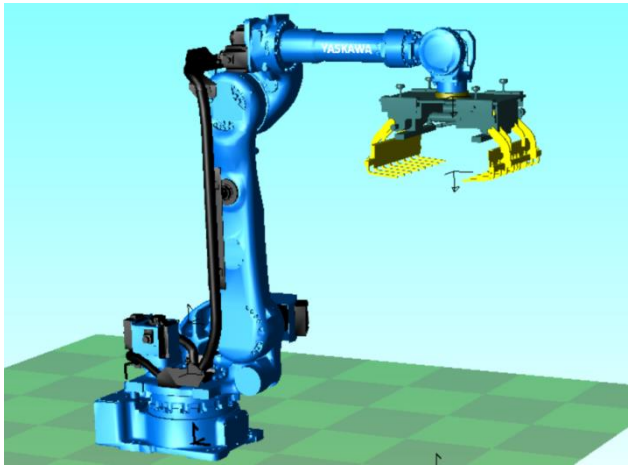

Fig.3 Yaskawa MPL0100 robot arm model and fixture model

3. Hardware Design

3.1. Main control chip

The main controller of the control system uses AT89C52 microcontroller, AT89C52 microcontroller has powerful functions and flexibility, suitable for a variety of embedded systems and control applications, belongs to CMOS8-bit microcontroller. Its advantages are mainly reflected in low power consumption, high performance, and flash memory [3], [4]. Receive the input signal collected by the sensor, and output the control signal to the driver chip, so as to control the robot to walk along the specified route and stop to the specified destination.

3.2. Power supply

In the whole system design, AT89C52 MCU is the control

center, and it is powered by 2 3.7V power modules. Information acquisition through the sensor, its operating voltage requirement is 5V, the use of AMS1117 regulator to achieve voltage regulation, AMS1117 is a cost-effective regulator, relatively low price, stable and reliable performance, At the same time, the AMS1117 regulator has the advantages of simple and easy to use, stable and reliable, low power consumption, overload protection, multiple output voltages and high cost efficiency. The operating voltage of the motor drive module in the device is 5 V, if the voltage is greater than 5 V, it is directly supplied by the power module.

3.3. Drive motor

The robot is usually driven by DC reducer motor, which can output large torque through the deceleration of the gear box [5]. After comparison and selection, the model JGB37-550 DC gear motor is selected. The JGB37-550 DC gear motor has the advantages of high torque, good stability, wide speed regulation range, high energy efficiency, high reliability and easy installation, which makes it widely used in many industrial and commercial applications.

3.4. Controls the robotic arm chip

In order to identify the grasping material workpiece, the color and shape of the material workpiece are used to identify the target. The recognition sensor adopts OpenMV3 vision module with MCU interface. There is a camera on the OpenMV3 module for taking images of objects, and the images taken are processed by AT89C52 microcontroller.

4. Module Testing

4.1. Ultrasonic obstacle avoidance module test

According to the actual working environment of the handling robot, the indoor environment is selected for ultrasonic obstacle avoidance test, obstacles are set, and ECH0 of the HC-SR04 ultrasonic module is connected to the needle J9-P2.0, TRIG is connected to J9-2.1, VCC is connected to J9-VCC, and GND is connected to J9-GND. The LCD1602 liquid crystal was installed in the LCD1602 socket of the single chip microcomputer, and the contrast of the liquid crystal was adjusted. Ultrasonic obstacle avoidance module test data is shown in Table 1.

Table 1. Ultrasonic obstacle avoidance module test data

Ultrasonic ranging(mm)	Ruler ranging(mm)	Error(%)
266.8	266.0	0.15
350.6	350.0	0.17
439.8	439.0	0.18
658.8	658.0	0.12
772.1	771.0	0.14

The error between the ultrasonic obstacle avoidance module's ranging value and the actual ruler's ranging value is less than 2%, which can realize automatic obstacle avoidance.

4.2. Infrared tracking module test

Natural light has a certain influence on the receiving ability of the infrared receiving tube, so the indoor environment test matching the actual use environment is used. Before the test, connect P3.2~3.5 of the pin J11 and P3.2~3.5 of the AT89C52. Place the robot on the white test bench, turn on the power, and fine-tune the potentiometer RW3 and RW4 in a clockwise manner until LED2 and LED light up. Infrared tracking module test data is shown in Table 2.

Table 2. Infrared tracking module test data

Transfer robot	Left infrared tube	Right infrared tube
Go forward	1	1
Back up	0	0
Turn left	1	0
Turn right	0	1

5. Conclusion

This paper takes the handling robot as the research object, uses the AT89C52 single chip microcomputer as the main control chip, uses the infrared tracking module, ultrasonic obstacle avoidance module, power module, motor module and robot arm module to design the handling robot, optimizes the shortcomings of some handling robots in the general working environment, improves the efficiency of logistics handling and reduces the risk of manual logistics handling.

Intelligent handling robot has broad development prospects. With the continuous progress of technology and the expansion of application fields, intelligent handling robots will play an important role in various industries, improve work efficiency, reduce costs, and

promote the intelligent transformation of the industry.

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