A Design and Implement of an Automatic Intelligent Car

Chengzhi Liu , Yizhun Peng*,Jikai Zhao , Dezhi Yang,
College of Electronic Information and Automation,
Tianjin University of Science and Technology, Tianjin, 300222,China;
*E-mail: * pengyizhun@tust.edu.cn*
www.tust.edu.cn

Abstract

In order to study the situation that some unmanned vehicles need to drive repeatedly on fixed lines, this article introduces an autonomous smart car based on the STM32 platform. Infrared detectors are used to determine whether the vehicle is driving on a prescribed route. Ultrasonic detectors can prevent the vehicle from colliding with other people or vehicles. Inexpensive cars can help express companies to transport packages and letters to reduce labor costs. Large vehicles can be used to carry large cargo such as containers in docks and other places.

Keywords: Automatic driving, Ultrasonic detectors, Infrared detectors, Parcel shipping

1. Introduction

With the development of online shopping and the impact of the epidemic, contactless delivery of goods is now of great importance. In universities and office buildings, cargo delivery robots are becoming more and more common, but high prices often limit their application scenarios. Recently, the China Post Bureau released the May Express Development Index Report. In May 2020, China’s express delivery development index was 344.2, an increase of 73.5% year-on-year. Among them, the development scale index, service quality index, development capability index and development trend index were 291.1. 622.4. 202.4 and 94.0, respectively. Upgrade, showing a development trend of capacity expansion and quality improvement.

2. Hardware design

2.1. Overall structure of the car

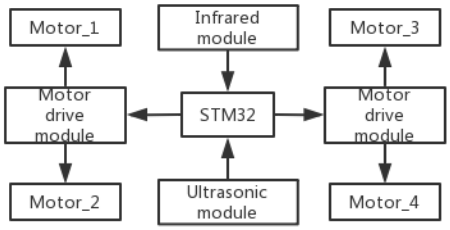

Fig.1.Block diagram of the overall structure

After setting the driving path in the main control of the car, the car will run independently. The ultrasonic module can transmit the signal of whether there are obstacles on the driving path to the car. The infrared module is responsible for the judgment of the driving path of the car, and the driving direction and speed of the car are automatically set by the main control.

2.2. Control section

STM32 microcontroller is used as the main control. The single-chip minimum system includes a display, matrix keyboard, A/D, D/A and other modules, which can significantly reduce the design of peripheral circuits and reduce the difficulty of system design.

The STM32 series microcontroller is a 32-bit microcontroller, based on the ARM Cortex-M3 core specially designed for embedded applications that require high performance, low cost, and low power consumption.

2.3. Drive section

- Step-down module

The step-down module can reduce the power supply voltage to the appropriate voltage required by the module, usually 5v and 3.3v. Therefore LM2596S were chosen DC-DC high-power DC voltage regulator board.

Fig.2.The step-down module

- Motor drive module

The TB6612FNG used in this design is a motor drive IC that can independently control two DC motors in both directions. It has a high degree of integration, and at the same time can provide sufficient output capacity, also has advantages in operating performance and energy consumption. Therefore, it can be used as an ideal motor drive device in an integrated and miniaturized motor control system.

Fig.3.The motor drive module

- Power module.

In terms of power supply, rechargeable batteries, the working principle is the mutual conversion of chemical energy and electrical energy. When the voltage is insufficient, it can be charged to keep the voltage stable, and the voltage can be maintained at a stable value, making the experiment more accurate. Rechargeable

Fig.4.The DC geared motor

batteries can be used multiple times, which is beneficial to protect the environment.In terms of environmental protection and convenience, the power supply module uses rechargeable batteries.

- DC geared motor

In order to enable the car to carry heavier goods and get the speed of the car, a DC geared motor with a reduction ratio of 30 is the better choice.The encoder based on Hall component can return the current speed of the car to the microcontroller to control the car.

2.4. Tracking section

TCRT500 infrared integrated transceiver based on infrared detection method is our choice. The infrared detection method uses the characteristics of different reflection intensities of infrared on the surface of objects of different colors to distinguish the current detection state. The infrared photoelectric tube can greatly reduce external interference. The circuit design is relatively

simple, the detection information speed is fast, and the market price is low.

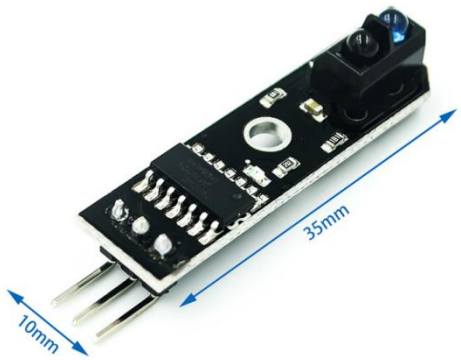

Fig.5.The infrared detection

2.5. Ultrasonic obstacle avoidance sensor

The model of ultrasonic obstacle avoidance sensor used in this car is ULB-1 ultrasonic distance sensor, which has the characteristics of high resolution, high precision and low consumption. Not only in the design but also in the interference noise processing, with anti-noise interference ability. And for the different size of the target and the change of the supply voltage, do the sensitivity compensation. In addition, it also has standard internal temperature compensation, which makes the measured distance data more accurate.

Fig.6.Ultrasonic obstacle avoidance sensor

3. Software design

3.1. Program function description and design ideas

When the car arrives at the loading area, it automatically stops waiting for loading, and the on-board weight detection system will automatically detect whether the weight of the goods exceeds the standard. After the loading is completed, it will drive to the unloading area according to the set path. During the driving process, it can automatically avoid obstacles and drive on large-angle slopes.

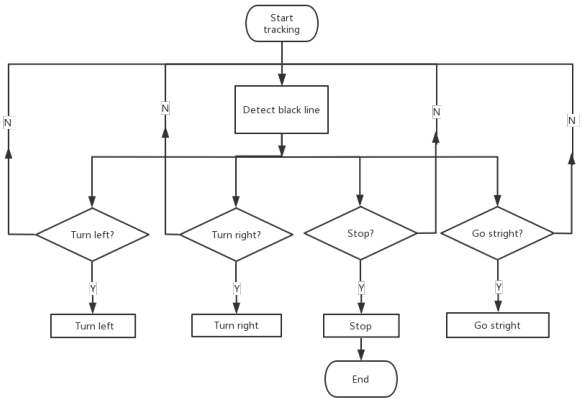

Fig.7.The system flow chart

3.2. infrared sensor

TCRT5000 infrared tracking module is our selected tracking module. The module has three leads: VCC, GND and OUT, and VCC is connected to a +5V power supply. After correct connection, it can be found that when the probe detects the driving track, the indicator light on the rear of the module will remain off, and the output of the OUT terminal will change to low level, and the OUT terminal will change to high level. Normally level.

3.3. DC motor driver

The rotation speed and direction of a motor are controlled by one PWM signal and two control signals. Pin definition of motor drive is shown in Tab.1

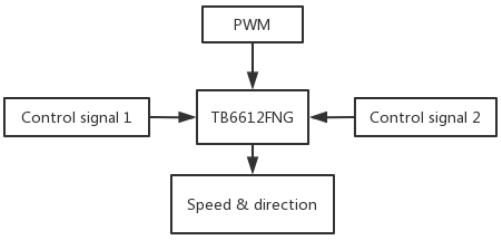

Fig.8.Block diagram of the motor driver

Tab.1.Pin definition of motor drive

Number	Name	Description
1	PWMA	Speed control pin of motor A
3	AIN2	Direction control pin 2 of motor A
4	AIN1	Direction control pin 1 of motor A
5	STBY	Drive enable pin (connect to VCC)
6	BIN1	Direction control pin 1 of motor B
7	BIN2	Direction control pin 2 of motor B
8	PWMB	Speed control pin of motor B
9	VM	Positive motor power supply
10	VCC	Logic power supply positive
11	GND	Logic power supply negative
12	GND	Motor power negative
13	AO1	A road motor output 1
14	AO2	A road motor output 2
15	BO1	B road motor output 1
16	BO2	B road motor output 2

4. Testing and conclusion

4.1. Test plan

- Detect the maximum mass that can be carried when the car is given maximum power.
- Lay complex lines on the ground to detect the functions of infrared tracking modules and algorithms.
- Put many cars on the line to run at the same time to detect the ultrasonic obstacle avoidance function.

Fig.9.Line inspection test

4.2. Test results

After multiple tests and repeated experiments, the maximum load of the car is 7.6 kg, and the load is 5 kg when the minimum speed is guaranteed. There is a certain probability of taking the wrong path when driving on a complex route, especially when multiple trajectories intersect in one place.

Fig.10.Weight test

References

1.Research on Application of Automated Warehouse Transportation Path Planning[D]. Teng Zhipeng. Changchun University of Technology 2020

2.Razvan Luca, Fritz Troester, Robert Gall and Carmen Simion,Autonomous parking procedures using ultrasonic sensors,Annals of DAAAM & Proceedings,Jan. 1, 2010 .

3. Wu Guojing, etc. Microcontroller Application Technology China Electric Power Press, 2004.1

4.Design and Research of Mobile Robot Control System Based on Automatic Guidance[J]. Li Peiying, Liu Weiliang. Innovation in Science and Technology. 2020(29)

5.Realization of obstacle avoidance technology for smart car[J]. Li Lei, Cao Shengwei. Micromotor. 2011(06)

6.Design and implementation of ultrasonic anti-collision speed measurement and obstacle avoidance instrument[J]. Su Qiumei, Liu Yarong. Science and Technology Innovation and Application. 2020(29)