ISSN: 2664-9640

Design of automatic tracking intelligent car based on infrared sensor

Xinhao Tong

Hubei University of Automotive Technology, Hubei 442000, China ;

202111203@huat.edu.cn

Abstract

Intelligent car has become a focus of research in the field of robotics. The car has the ability to drive and perform tasks autonomously, thus reducing the burden of human work. In these application scenarios, cars need to be able to address automatically in an unsupervised environment, which requires them to be highly intelligent and flexible. To meet this requirement, researchers use a wide range of sensors to detect information about the surrounding environment. Among them, infrared sensor is a kind of common sensor, it can transmit and receive infrared signal, and is widely used in the design of intelligent car. Therefore, this paper aims to design an intelligent car based on infrared sensor to realize the function of automatic tracking. The design of this intelligent car uses single chip microcomputer as the main control element, and uses infrared module for signal transmission and reception. Single-chip microcomputer is burned processing program, automatic processing and output signals, thus controlling the motor drive. Therefore, the intelligent vehicle has infrared tracking capability and can provide basic model for multi-functional intelligent vehicle research projects in special occasions.

Keywords

Infrared sensor; Automatic tracking; Smart car.

1. Introduction

With the continuous development of human society, intelligence has become the trend of current social development. As a kind of intelligent robot, infrared tracking intelligent car[1] has a wide range of application prospects. For this kind of intelligent vehicle, infrared sensor[2] is widely used, which can achieve the purpose of autonomous tracking by detecting infrared signals in the environment. Therefore, based on the SCM infrared tracking intelligent car as the research background, this paper will discuss the principle of infrared sensor, and study its application in automatic tracking.

In this paper, the principle and classification of infrared sensor are described, and its application range and advantages in automatic tracking are introduced. Then, according to the characteristics of the infrared sensor, an automatic tracking circuit with high sensitivity and stability is designed, and combined with the single chip microcomputer, infrared tracking intelligent car based on the single chip microcomputer is realized. Finally, the intelligent vehicle is tested and analyzed through experiments, and its autonomous tracking ability and excellent performance are verified.

The research results of this paper have good application value: on the one hand, the intelligent car can be applied to industrial automatic production line[3], to help manufacturers realize intelligent production line; On the other hand, the smart car can also be used in the automatic management of warehouse shelves, hospital handling, logistics and distribution[4] fields. In a word, based on SCM infrared tracking intelligent car has a wide range of application prospects.

ISSN: 2664-9640

2. Working principle and characteristics of infrared sensor

Light is a type of electromagnetic radiation, usually referred to by the human eye can see the light wave domain, ranging from 400nm (purple light) to 700nm (red light). In addition to red light, radiation with wavelengths between 760nm and 1mm, called infrared, cannot be seen by the naked eye but can still be felt by special optical devices.

Infrared is a type of light that cannot be seen by the human eye and therefore has all the properties of other light rays. However, it also has a significant thermal effect, which makes it a unique kind of light. All substances at temperatures above absolute zero, or -273 degrees Celsius, produce infrared light. Infrared sensors can be divided into active and passive two kinds:

(1) Working principle and characteristics of active infrared sensor

With an active infrared sensor, the transmitter sends out a modulated infrared beam, which is picked up by the infrared receiver to form a warning line. The alarm should not be triggered when objects such as leaves, small animals, snow, dust and fog are in the way. The alarm will only be triggered if a person or a large object is blocking it. Active infrared detector technology generally adopts one-shot and one-shot, which can form linear prevention. Now it has been developed to multi-beam technology, and even double-send and double-receive technology. These techniques can minimize false positives and improve product stability and reliability.

(2) The working principle and characteristics of passive infrared sensor

Passive infrared sensor works by detecting infrared radiation emitted by human body. It collects infrared radiation from the outside world and concentrates it on sensors. Normally, the infrared sensor uses pyroelectric elements, when the temperature change of infrared radiation will be released outward charge, and then detection processing and alarm. The goal of this sensor is to detect human radiation, so it needs a highly sensitive radiation sensitive element to infrared radiation with a wavelength of about 10um. In addition, in order to enhance the sensitivity to human infrared radiation, special filters are usually set on the radiation surface of the sensor to effectively control the interference of the environment.

This paper uses the active infrared sensor, its advantage in the automatic tracking car is that it can detect the black line on the ground, so as to achieve automatic tracking.

3. Design of automatic tracking system

The design of automatic tracking car includes infrared sensor circuit and driving circuit. Mainly through the infrared sensor to identify the ground black line, through the identification results, control motor rotation to control the car to turn left, right and forward and other tracking actions. The operation of the smart car is shown in Figure 1, and the physical picture of the smart car is shown in Figure 2:

3.1. Infrared sensor circuit design

The working principle of the infrared sensor is that the transmitter of the infrared sensor sends out a modulated infrared beam, which is received by the infrared receiver. Where: if the receiver receives the reflected infrared reflected light, the circuit is switched on; On the contrary, if no reflected light is received, the circuit will not be switched on. Using this principle, we can design a circuit to detect whether the smart car deviates from the route. The circuit diagram of infrared sensor is shown in Figure 3:

ISSN: 2664-9640

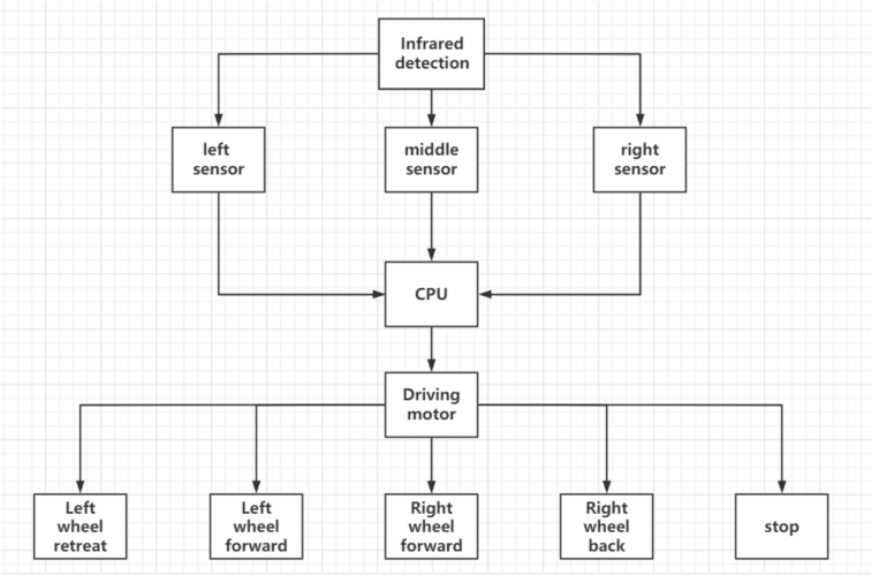

Figure 1 Operation diagram of the intelligent car

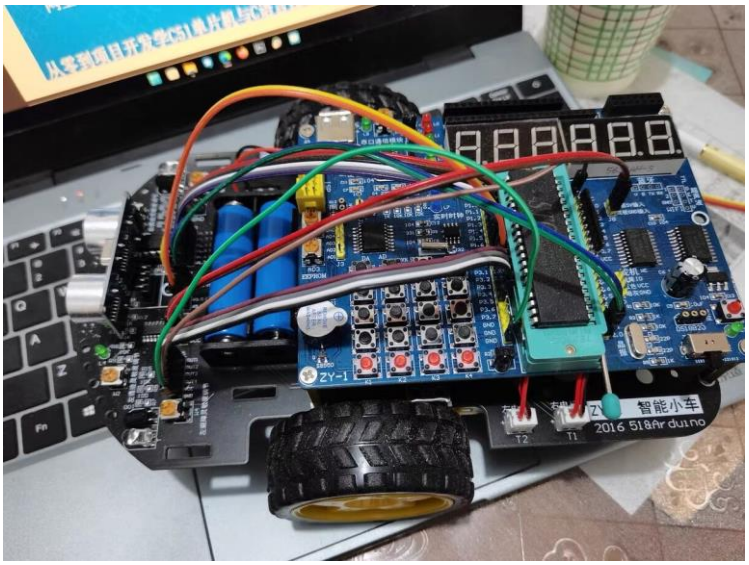

Figure 2 Physical picture of the intelligent car

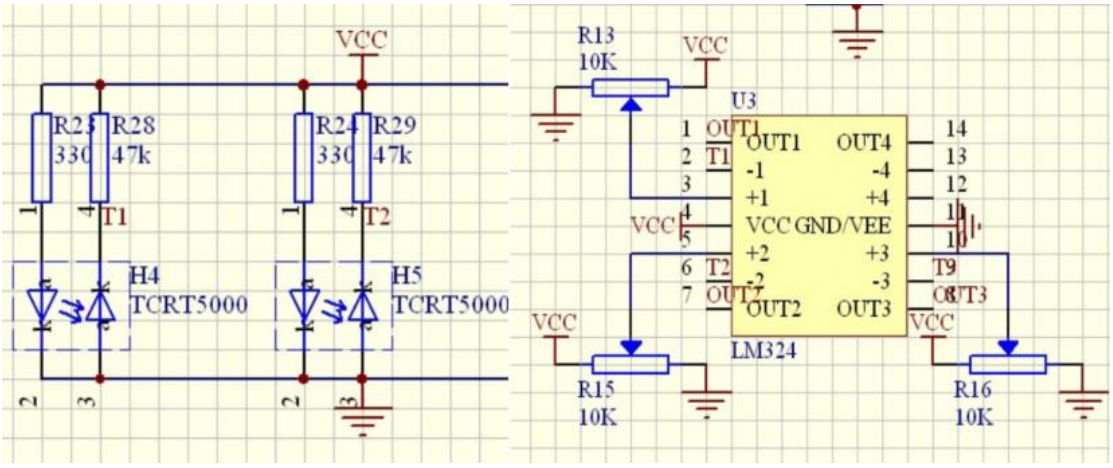

Figure 3 Circuit diagram of the infrared sensor

According to Figure 3, if no black line is detected, the H4 transmitting end will emit light and reflect it to the receiving end of H4. At this time, if H4 is switched on, T1 grounding =0; However,

ISSN: 2664-9640

if a black line is detected, all the light of H4 is absorbed by the black line, resulting in no signal received by the receiver of H4, so H4 is cut off, T1=VCC. This is used for tracking road detection.

3.2. Drive circuit design

The intelligent car has two driving wheels, which are driven by two independent DC motors respectively. The wheels run at different speeds by using the different speeds of the two motors to achieve forward, left, right turn and other actions. The driving circuit mainly adopts the L298N control chip, and the motor driving circuit diagram is shown in Figure 4:

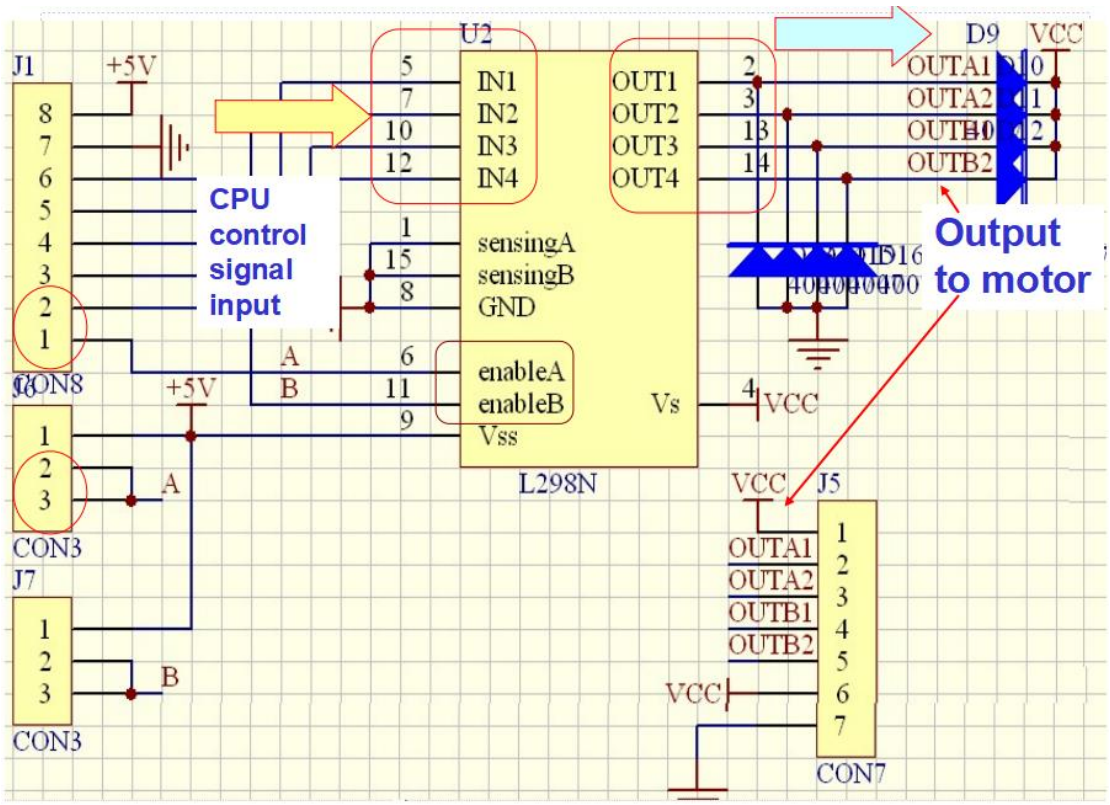

Figure 4 Motor drive circuit diagram

As can be seen from Figure 4, the MCU outputs the control signal from OUT1,OUT2,OUT3,OUT4 to the motor through IN1,IN2,IN3,IN4 input, where OUT1 and OUT2 are connected to two electrodes of the right motor respectively, and OUT3 and OUT4 are connected to two electrodes of the left motor respectively. The specific running state is shown in Table 1 (where 1 is high level and 0 is low level) :

Table 1 Motor Operation Table

Left motor			Right motor			intelligent car status
OUT4	OUT3	status	OUT2	OUT1	status	
0	0	No turn	0	0	No turn	Stop
0	1	Forward	0	1	Forward	Forward
1	0	Back	1	0	Back	Back
1	1	No turn	1	1	No turn	Stop
1	1	No turn	0	1	Forward	Left turn
0	1	Forward	1	1	No turn	Right turn

ISSN: 2664-9640

4. Experimental results and analysis

This design uses the infrared sensor composed of three infrared transmitters and receivers on the line is other methods, to complete the identification of different paths, and control the intelligent car to complete the forward, left, right turn and stop each specific action, also completed the intelligent car from the initial position, to reach the target location automatically stop the overall design. All possible situations received by the sensor during operation are shown in Figure 5:

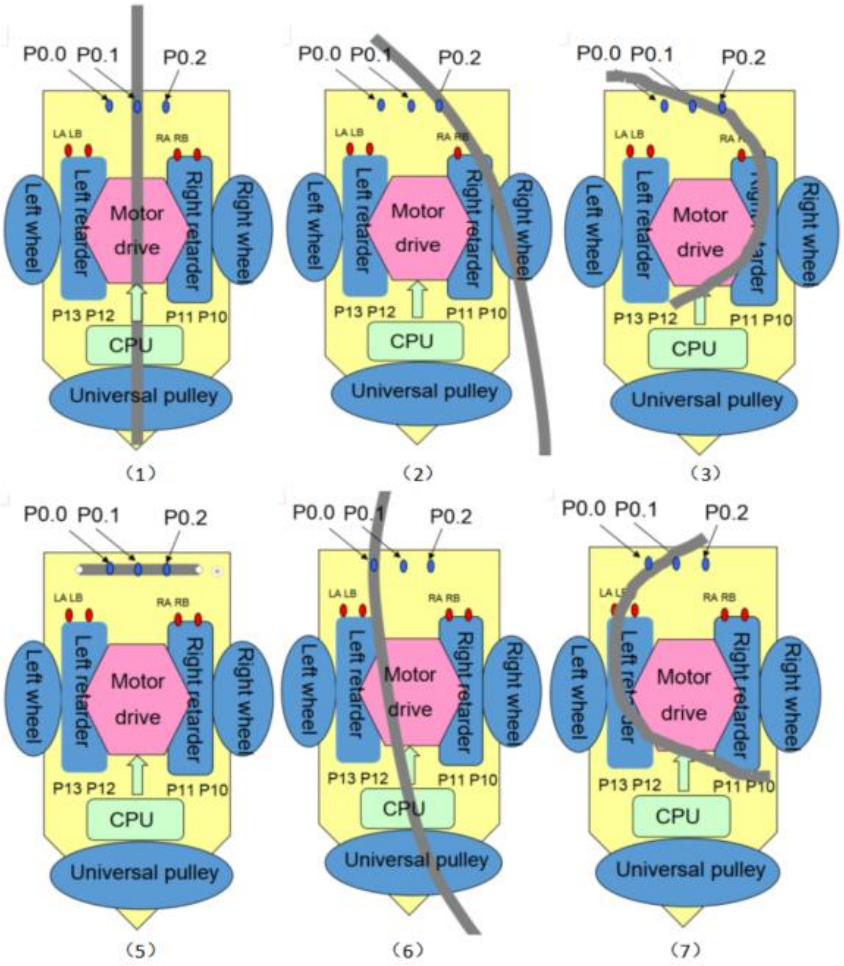

Figure 5 The sensor accepts the signal type

As can be seen from Figure 5, there are six situations in the operation of intelligent vehicles, and the corresponding measures after each situation occurs are shown in the table below:

(1)If the middle detection head P01 detects a black line, then the car moves forward;

(2)If the black line is detected by the right detection head P02, the car will deviate and turn left;

(3)If the detection head P01 and P02 detect black lines, it means that the car is currently deviating from the normal running track, and at this time the car turns left.

(4)If the three detection heads all detect the black line, the car reaches the end point and stops;

(5)If the black line is detected by the left detection head P00, the car will deviate and turn right;

(6)If the detection head P01 and P00 detect the black line, it means that the car has deviated from the normal track at present, and at this time the car turns right;

When the infrared sensor detects the black line, the emitted light will be absorbed by the black and will not reflect back the light. At this time, the corresponding probe is low. In the above six cases, the specific control voltage of the motor is shown in Table 2:

ISSN: 2664-9640

Table 2 Electric Motor Control Sheet

infrared sensor				Motor drive controls the motor pin				
P02	P01	P00	The car state	OUT14	OUT13	OUT12	OUT11	car action
0	0	0	stop	1	1	1	1	stop
0	0	1	right-leaning	1	1	0	1	left turn
0	1	1	right-leaning	1	1	0	1	left turn
1	0	0	left-leaning	0	1	1	1	Right turn
1	0	1	Median driving	0	1	0	1	forward
1	1	0	left-leaning	0	1	1	1	Right turn

In the experiment, we conducted a series of tests to evaluate the performance characteristics of the automatic tracking vehicle based on infrared sensor. We analyze the auto tracking performance of the car under different conditions, and make detailed statistics and analysis on the experimental data obtained. Happily, our experimental results show that the designed automatic tracking car has good automatic tracking ability and stability. This excellent vehicle can not only navigate through a variety of complex environmental conditions, but also intelligently capture position and avoid obstacles, thus achieving higher navigation accuracy and efficiency. Therefore, we believe that this automatic tracking vehicle based on infrared sensor is a reliable technology with wide application prospects.

5. Conclusion

This paper introduces a research on the design of automatic tracking function and control system based on infrared sensor. We use sensors to collect data, and then process and analyze the data, and finally realize the automatic tracking function of the car. In terms of control system design, we adopt a series of efficient and stable algorithms to ensure the safety and stability of the car in the process of driving. The research results have a wide range of applications, such as intelligent transportation, logistics distribution and security. It not only plays an important role in promoting the development of modern society, but also provides a reference for the relevant research in these fields and helps to promote the development and application of relevant technologies. Therefore, the research results of this paper not only have practical significance, but also have guiding significance, which can provide enlightenment and direction for future research.

References

[1] Li Jinyan. Since the design and implementation of intelligent tracing car control system [J]. Integrated circuit applications, 2022, 33 (12) 6:10-13. DOI: 10.19339 / j.i SSN. 1674-2583.2022.12.004.

[2] Chen Yin, Li Xiang, Zhang Renyong. For moving target recognition based on pyroelectric infrared sensor method [J]. Journal of laser, 2023, 44 (02) : 181-185. The DOI: 10.14016 / j.carol carroll nki JGZZ. 2023.02.181.

[3] ZHANG Hongbing. Application of Intelligent Manufacturing Technology in Industrial Automatic Production Line [J]. Paper Making Equipment and Materials,202,51(01):13-15.

[4] Huang Yu, Bo Na. Intelligent logistics distribution in car production application [J]. Journal of automotive technicians, 2022 (6) : 60-64. The DOI: 10.16173 / j.cnki.ame. 2022.06.010.