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Intelligent Tracking Car Based on MSP430F5529

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Abstract: In order to improve the tracking stability of the tracking car on the ramp, a scheme to improve the intelligent tracking car was proposed.In this scheme, MSP430F5529 embedded development board is used as the control core, L298N driven by stepping motor, LM1117, 7805 and 7812 integrated regulators are used as the driving circuit, and TCRT5000 module is used for tracking and detection.The experimental results show that the ramp driving car not only has high tracking accuracy and stable performance, but also can identify the path more quickly and reduce the scanning time by adding multiple tracking modules.Through multiple power supply, enhance the car's uphill performance.

1. Introduction

At present, in the enterprise production technology continues to improve, the deepening of automation technology requirements of the environment, intelligent vehicle and intelligent vehicle based on the development of products have become the key equipment of automated logistics transportation, flexible production organization and other systems.Tracking Car is the predecessor of a series of high-tech products such as unmanned vehicles, military detection cars and intelligent furniture.At present, the traditional tracking car on the market is not high precision, must rely on a large area of reference units for tracking, the system performance is not high, affect the tracking speed and tracking direction of the car.Under the background of the continuous progress of science and technology and the role of tracking in modern social life and industrial production, how to improve and perfect the performance of tracking car has become an important problem to be solved in this field.This article USES the infrared sensors TCRT5000, MSP430F5529 embedded chip as the core, has designed and produced a particular track, according to tracking the tracking of the car, tracking the car can drive on different slope of the ramp and may not be out of the center line of the orbit, can design speed, and the car no tyre tracks and a thorn.The tracking car[1] track environment diagram is shown in Figure 1.

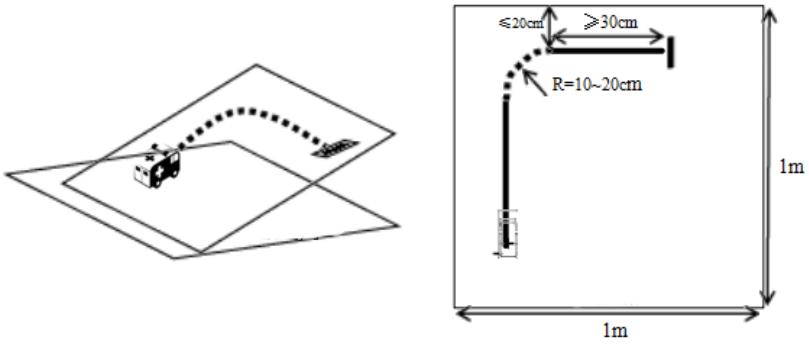

Fig.1 Track the Car Track Environment

2. System Structure Design

2.1 Overall Structure of Intelligent Tracking Car

The intelligent tracking car system is shown in Figure 2.The whole car adopts the idea of modular, mainly including MSP430F5529 development board, L298N driver,

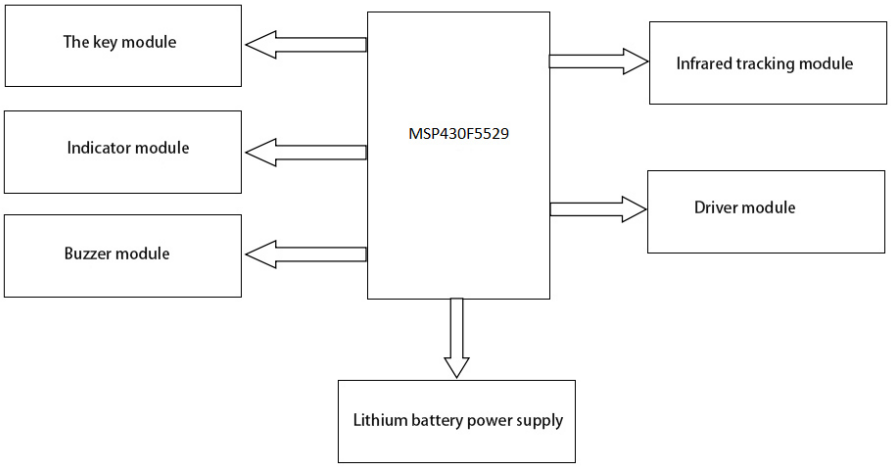

Fig.2 Tracing Trolley System

power module, tracking module, ranging module, buzzer module.The working process of the intelligent tracking car is as follows: 3 photoelectric sensors detect the path information, and transmit the obtained information to the MSP430F5529 chip for processing. The algorithm imported in the chip sends out control commands to the driving system, and controls the tracking car to track along the specified black line path.

2.2 Principle of Intelligent Tracking Car System

The intelligent tracking car[2] adopts four-wheel drive, and the speed of four wheels is controlled by the output PWM control signal of MSP430F5529 development board.The tracking track[3] uses a 1cm×1cm black and white spaced strip, and the strip is laid on the board. Because the reflection coefficient of black and white light is different, the control chip judges the tracking according to the signal transmitted back by the TCRT5000 sensor.Three tracking module in car front line, the small car in the process of tracking, the launch of infrared sensor is infrared light,

because the black can absorb infrared light, so by whether can receive the reflected infrared light to detect whether a black line, will determine the signal into high and low level change, MSP430F5529 development board with the sensor signal changes accordingly.This design uses 3 tracking modules. When the middle tracking module detects the black line, the car moves forward normally.When the black line is detected by the left tracking module, the car turns left.When the right tracking module detects the black line, the car turns right.Because the tracking module is very close to the ground, it improves the tracking accuracy and has good anti-interference ability in the process of running on the ramp.

3. Hardware Circuit's Design

3.1 Power Module

Considering the need to supply power to one embedded development board and two motor drives, and the different voltage ratings required for each device, the power module uses three integrated voltage regulators to provide stable voltage.The standard voltages of 5V and 12V are provided by using DC power to connect to 7805 and 7812 integrated regulators, and 3.3V are provided by connecting to LM1117 three-terminal regulators.

3.2 Buzzer Module

The MSP430F5529 development board is programmed and designed by combining LED light and buzzer. When the tracking car arrives at the end, the buzzer will alarm and the LED light will light up. The experimental results show that the buzzer alarm performance is good.

3.3 Motor Drive Module

The tracking car uses L298N integrated module to control the mechanical movement, which contains a 4-channel logic drive circuit, which can drive a two-phase stepper motor or a four-phase stepper motor.High working voltage, maximum working voltage up to 46V, continuous working current of 2A. High voltage and high current full bridge driver with two H Bridges.Through the I/O output of MSP430F5529 development board to change the level of the control end of the drive module, the motor can be reversed and stop operation, very flexible.The power of the system is mainly provided by four stepper motors.The step motor is driven by L298N.The I/O port of the MSP430F5529 development board is connected with the IN1-IN4 interface of the L298N to realize the control of the forward rotation, reverse and stop of the motor, as shown in Figure 3.

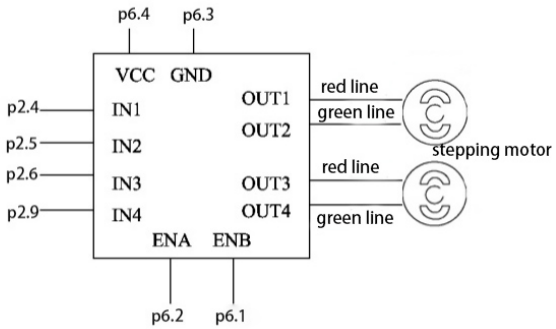

Fig.3 Connection of L298n to Development Board

3.4 Tracking Module

The tracking car adopts TCRT5000 photoelectric sensor for tracking. The TCRT5000 photoelectric sensor is composed of high emission power infrared photodiode and high sensitivity phototransistor. The output signal is shaped by Schmitt circuit, which is stable and reliable.The connection schematic diagram of TCRT5000 and MSP430F5529 development board is shown in Figure 4.Adopt four wire SPI connection mode.The MSP430F5529 chip reads the data amount of the tracking module by connecting D0, and the analog amount of the tracking module is read by connecting A0. According to the digital signal and analog amount read, the tracking car is driven to make the next action by the code.

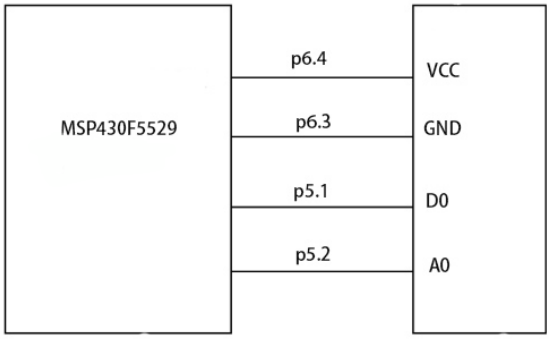

Fig.4 Tcrt5000 is Connected to Msp430f5529

3.5 The Key Module

MSP430F5529 development board comes with two buttons, programming design on the development board, design a button for the start button, a button for switching speed button.The experimental results show that when the button 1 is pressed, the tracking car program starts, and the whole car system runs.When the button 2 is pressed, the car can switch between high speed and low speed.

4. Software Design

4.1 Software Component

The total program includes infrared sensor detection, motor drive, key control, buzzer alarm and other parts.

4.2 Sensor Detection

Tracking the car[4] is on the basis of TCRT5000 sensor detects the data tracking, TCRT5000 module relies on do I/O port to send data to the MSP430F5529 chip 1 or 0, to program MSP430F5529 chip design, sets the p5.1 port to receive port, when the received digital signal 1, on behalf of the black line is detected, when receives the digital signal is 0, on behalf of the black line not detected.

In order to improve the tracking accuracy and accuracy, the tracking car needs to detect 1cm*1cm black block, so the tracking car adopts three TCRT5000 tracking modules, and in order to reduce the tracking error, combined with the requirements of uphill, the tracking module is connected to the car in a very low way.

The working process of the tracking module is as follows. When the middle tracking module detects the black line, and the tracking modules on both sides do not detect the black line, then the

tracking car drives in a straight line and does not turn;When the black line is detected in the tracking module on the left, the chip controls the motor on the left to slow down the speed, and the motor on the right to increase the speed, that is, the tracking car deflects to the left;When the tracking module on the right detects the black line, the chip controls the motor on the left to increase the speed, and the motor on the right to slow down the speed, that is, to deflect the tracking car to the right.The specific working flow chart of the tracking module is shown in Figure 5.

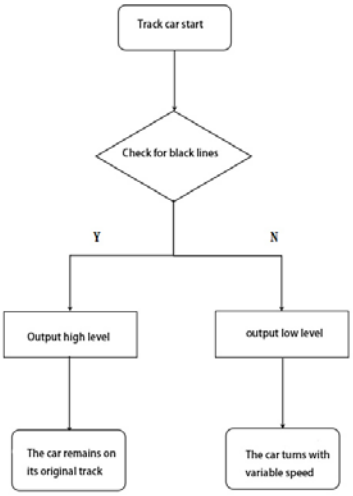

Fig.5 Tracing Module Workflow

4.3 Motor Drive

The principle of L298N driver is composed of 4-bit logic sequence, and each logic case corresponds to a different driver situation.Tracking the car by three tracking module detect black line at the same time, therefore, when carries on the programming design, to make judging to three tracking module respectively, such as when the left tracking module detects the black line, MSP430F5529 chip L298N drive transmit digital signals, the IN1 set to low potential, IN2 for high potential, IN3 for low potential, for low potential IN4, such turn left at the L298N drive the car can be driven by operation, other similar programming design.

4.4 Key Control

Track car can freely control the time, in the programming design of key control, the use of C language to write, set two key variables, respectively, the car start, car high and low speed switch button.When the switch between high and low speed is not pressed (the default state is high speed), the MSP430F5529 chip immediately sends a signal to the L298N driver to increase the speed and go full speed.When the switch button of high and low speed is pressed, MSP430F5529 sends out a signal to control a certain rotational speed and move forward at a uniform speed.

4.5 Software Process

The control motor and key control program is written in C language, TCRT5000 [5]tracking detection is written in assembly language, CCS compilation environment. After writing the test and no grammatical errors, the code is written into the MSP430F5529 chip[6] with the import function of CCS, and then connected with each device.The main program flow chart is shown in Figure 6.

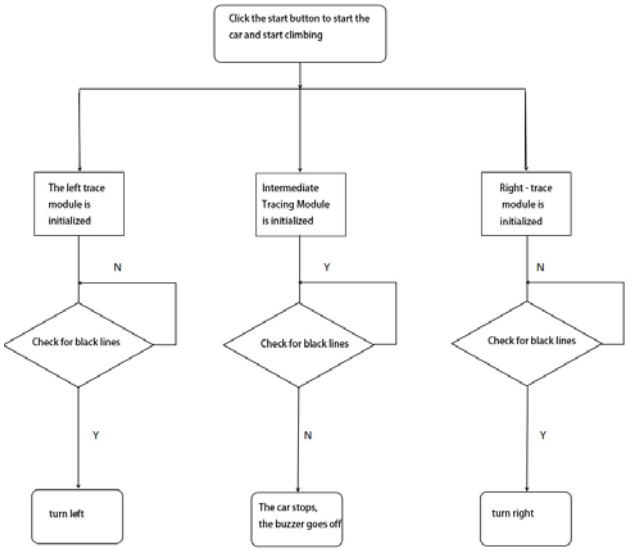

Fig.6 Master Program Flow Chart

5. Trolley Test and Analysis

5.1 Testing Environment

Prepare a 1m×1m wooden board with 1cm×1cm black and white spaced strips on the surface of the board.Use compasses to control the turning radius within 10~20cm, the parallel slope top distance of the marking line is 40cm, and the total length of the marking line is 1m.The stop sign is a black strip 1cm wide and 5cm long, perpendicular to the mark line at the top of the slope.

5.2 Test Preparation

Put the four lithium batteries into the power slot of the car, place the car parallel to the board, press the start button, and test whether the car will make corresponding operation according to the direction of the black strip.Check whether the wheels turn normally, the keys to control the speed change can work normally.

5.3 Results Analyse

Change the different slope, and control the car at different speeds for track test.The test results are shown in Table 1.

Table 1 Test Result

time^{slope}	0°	10°	20°	30°	40°	45°
slow(s)	9	12	14	16	18	20
fast(s)	6	8	10	12	15	17

Through the comparison of several experimental results, it can be found that the tracking car can run normally on the slope below 45°, because the car adopts 3 tracking modules and the ultra-high processing speed of MSP430F5529 chip, and the error deviation is basically 0 in the process of driving according to the track. When the slope is greater than 45°, the car will have wheel skidding phenomenon when turning, and the distance from the center is greater than the distance required by the race. According to the analysis of the experimental results, under the power supply of 4 lithium

batteries, the trolley can provide enough power below the slope of 45°, When the slope is greater than 45°, according to the calculation of friction force, the tracking trolley cannot provide enough pressure, resulting in insufficient friction force and skid.If the tracking car wants to climb the slope above 45°, it can be controlled by adding a pressure device on the car. At different slopes, the pressure device can implement different pressures, so as to increase the friction force of the car, and the car has enough power, so that the car can reach the end point without skidding.

6. Conclusion

In order to improve the tracking stability of the tracking car on the ramp, each module of the tracking car is designed, which can better achieve the following functions.

1) The tracking car can ride along the marked line automatically and park at the parking point;The vertical distance error between the mark point on the car and the center line of the stop sign is less than 2cm.When parking, tracking car buzzer will give an alarm sound.

2) At the same slope, the tracking car can set its traveling time by itself, i.e. switch to different speed modes, and automatically control the tracking car to pass through the 1-meter long road and park at the parking point.

3) The car can run at a gradient of 11°~45° according to the regulations, and it will not run over or break away from the marked line during the driving process.

4) When the car runs on tracks with different slopes, it moves at a uniform speed.

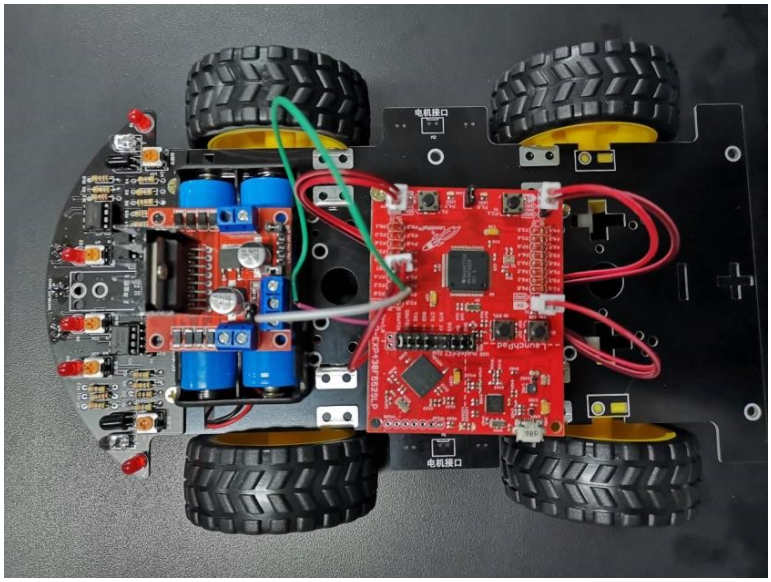

Fig.7 Entity

The test results show that the whole tracking car can complete the slope below 45° well under the control of MSP430F5529 chip, and it does not run over or break away from the mark line during the driving process. The tracking car adopts three tracking detectors, which breaks the design rules of traditional tracking car, and the tracking car adopts low detection module to provide detection accuracy. Multiple lithium batteries are used to power the car with stable performance and sufficient power. Tracing car adopts MSP430F5529 chip, processing speed is fast, detection can make a response in time, and the car program adopts PID algorithm, the car will not stop in the process of turning. If tracking the car to the bigger slope gradient on the last try many methods, found that the increased pressure is the most effective method, if have a chance to see this car was improved, add a

controlled by MSP430F5529 pressure, so in the process of hill, is on the basis of the size of the gradient, pressure device to implement different pressure to increase the friction force of tracking car, physical diagram as shown in figure 7.

In practical application, driverless cars can be used through the principle of tracking cars, and the improvement of driving accuracy of driverless cars will make the safety performance of cars higher. The same tracking car can also be applied to military detection, in some special environments, unmanned tracking detection needs to be used, tracking car will be sent on the great use.

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