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A Wheeled Obstacle Avoidance Robot Based On Arduino Microcontroller by fuzzy controller

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Abstract:

In this paper, one of the basic functions that each self-propelled robot must have is to detect and avoid obstacles during movement, while still performing current tasks such as orbiting, tracking. The paper presents studies on the fuzzy controller combination to perform the functions of tracking and avoiding obstacles for a wheeled self-propelled robot, with two independently controlled active wheels. The ultrasonic sensors are used to detect and determine the distance from the robot to the obstacle, as input data for the obstacle avoidance fuzzy controller. The experiments with different types of obstacles and movement patterns in the laboratory environment gave good results, showing the correctness of the algorithm and the effective working ability of the combined fuzzy controller.

Keywords: Robot, Arduino, Avoid obstacles.

1. Introduction

With the development of 4.0 technology, the development of robots into today's life has taken shape. In today's life, in order to be more efficient, reduce labor resources by applying automation methods such as automatic operating robots, intelligent driving, etc. It has been applied in military, civil and scientific research, and it provides a new way to solve the problem of road traffic safety. Realize custom designed automatic tracking function, to solve various hazards and unnecessary loss caused by deviating from the route in real life, the robot is to achieve the target point from starting point and avoiding obstacles.

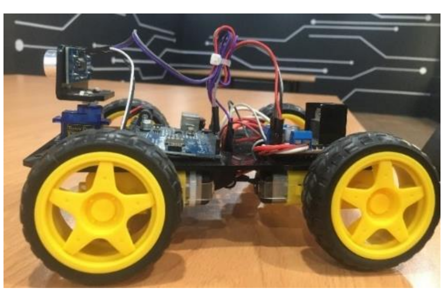

Figure 1: Completed robot model.

2. Overall system design

External information collected by various sensor modules in the system is transmitted to the main control unit through the signal terminal, which is then detected by the Arduino controller in the main control unit. price. transmitted by each module. The Arduino central controller is responsible for receiving and processing data, and communicating commands to the various modules of the wheeled robot based on the relevant content of the data for the robot to complete Accurate tracking and obstacle avoidance commands.

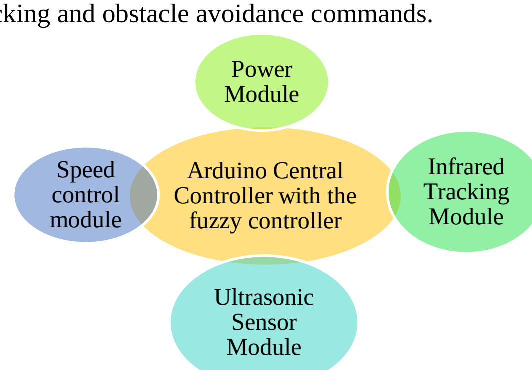

Figure 2: System structure of obstacle avoidance robot

3. System hardware design

3.1 System hardware wiring diagram

The control system of the obstacle avoidance robot is based on the main control system Arduino

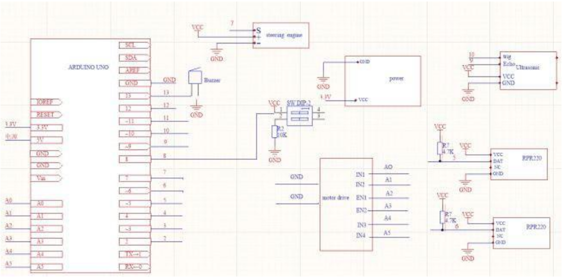

Figure 3: Design wiring diagram based on PSIM software

In the design of the system, 5 parts of motor drive module, ultrasonic sensor module, photoelectric sensor tracking module, automatic speed control module and power module designed and completed. Each module has been carefully designed and tested many times before being fully integrated into the robot's overall design framework. Figure 3 is the hardware wiring diagram of the design [1-3].

3.2 Deployment of the SRF05 Ultrasonic Sensor Module

It mainly uses the VCC pin as the power supply to support the ultrasonic module. After passing the host chip's TTL trigger signal into the TRIG pin, it can generate eight 40kHZ cycle levels and output an audio signal. When the signal is sent, the ECHO pin sends a high level reverberation signal to the main chip to achieve ultrasonic range for smart cars. control core and uses ultrasonic sensors to recognize the detection of obstacles on the road [4]. It can make the intelligent car automatically avoid obstacles and realize different driving speeds, and also has an automatic search function. The future has broad application prospects.

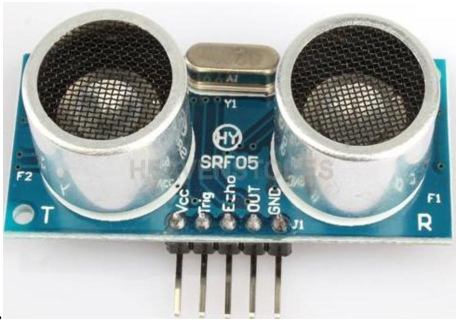

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Figure 4: Ultrasonic sensor module SRF05

This mode uses separate trigger and feedback pins, and is the simplest mode to use. All programs typical for the SRF04 will work for the SRF05 in this mode.

- SRF05 timing scheme, mode 1.

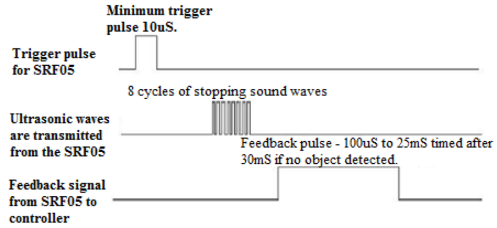

Figure 5: Timing diagram of SRF05 mode 1.

- Mode 2 – use one pin for both trigger and response.

This mode uses a single pin for both trigger and feedback, and is designed to store the values on the pin onto an embedded controller. To use this mode, connect the mode pin to the ground pin. The feedback signal will appear on the same pin as the trigger signal. The SRF05 will not increase the feedback current until 700uS after the end of the trigger signals. You've had time to trigger the pin around and make it an input and to have your code pulse ready [4-5]. The PULSIN instruction was discovered and is commonly used today for automatic control. To use mode 2 with basic BS2 Stamps, you can simply use PULSOUT and PULSIN on the same pin, like this:

- SRF05 timing scheme, mode 2.

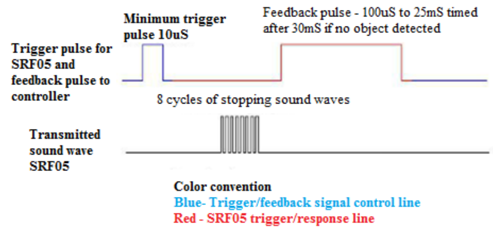

Figure 6: SRF05 mode 2 timing diagram.

• SRF05 PIN 15' uses pin for both and echo enabled

• Range VAR word 'specifies a 16-bit variable range'

• SRF05 = 0 'start with low pin

• PULSOUT SRF05, 5' gives 10uS pulse trigger (5 x 2uS)

• PULSIN SRF05, 1, Range 'echo time measurement

• Range = Range/29' to convert to cm (divide 74 by inches)

- Calculate the distance of the SRF05 ultrasound.

The SRF05 timing scheme shown above for each mode. You just need to supply a short 10uS pulse that triggers

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the input to start measuring the distance. The SRF05 will send out an 8 burst cycle of ultrasonic at 40khz and boost its feedback current (or enable stream mode 2). Then wait for the response, and as soon as it detects it drops the response lines back. The feedback current is a pulse whose width is proportional to the distance to the object. By measuring pulse, it is possible to calculate distance in inches/centimeter or whatever. If nothing is detected the SRF05 drops below its feedback current after about 30mS [6-7].

The SRF04 provides a feedback pulse proportional to the cavity. If pulse width is measured in uS, then dividing by 58 gives the distance in centimeters, or dividing by 148 gives the distance in inches. uS/58 = cm or uS/148 = inch. The SRF05 can be activated rapidly with every 50mS, or 20 times per second. You should wait 50ms before the next trigger, even if the SRF05 detects a close object and the response pulse is shorter. This is to ensure the "beep" ultrasounds have faded and will not cause false positives on the next measurement.

- Other settings of pin 5.

Pin 5 is ringed as "programming pins" that are used only once in the manufacturing process to program the Flash memory on the PIC16F630 chip. The programming of the PIC16F630 pins is also used for other functions on the SRF05, so make sure you don't connect anything to the pins, or you will interrupt the module operation.

- Change the beam and beam width.

Can you! This is a frequently asked question, however there is no easy way to reduce or change the beam width. The beam of the SRF05 is conical with the beam width being a function of the surface area of the sensors and is fixed. The beam of the sensor used on the SRF05, taken from the manufacturer's data sheet, is shown below [8].

4. System software design

4.1 Overall framework for software design

The software design is divided into four modules: infrared tracking module, ultrasonic object avoidance module, motor drive module, power module and so on. According to the photoelectric sensor tracking logic and hardware analysis of the vehicle tracking function, the module software design tracking flow chart of the smart wheel type robot shown in Figure 3 is realized.

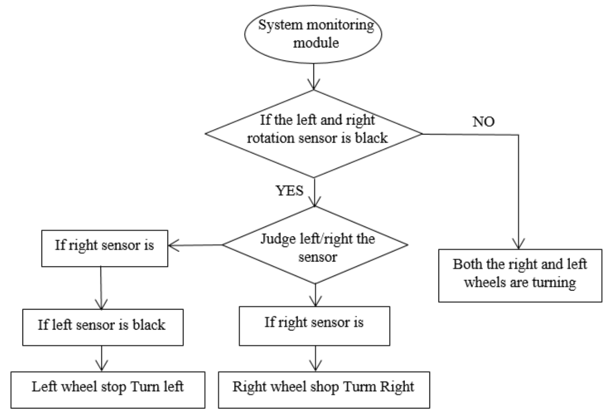

Figure 7: System monitor module flow diagram

In this design, the obstacle avoidance module mainly adopts the traditional ultrasonic obstacle avoidance method, so the intelligent robot walking strategy is based on the ultrasonic range logic. Figure 8 is a graph to plot obstacle avoidance based on obstacle avoidance logic.

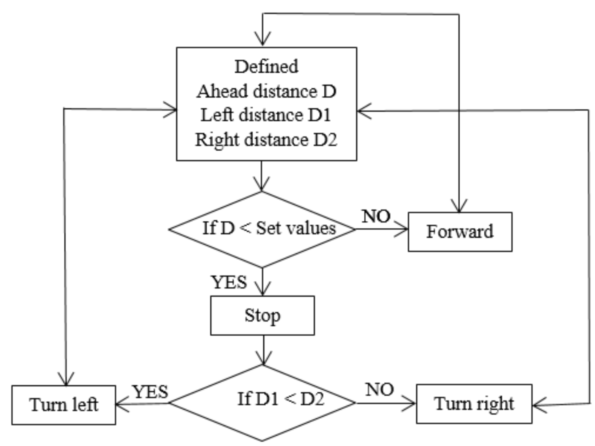

Figure 8: Obstacle avoidance flowchart

4.2 Power module

The power module of this design consists of two 3.7V, 1200mAh rechargeable battery packs, which are directly connected to the Arduino control board and motor drive module to power them. However, if you don't use 3.7V lithium. battery, you will need to use a DC-DC boost module. By adjusting the rheostat SVR1 of the DC-DC boost module, the output voltage is 5V, and then it is connected to the Aruino control board and the motor control module via the DuPont line.

Figure 9: Motor control source and Arduino

4.3 Speed control module

During robot tracking, if the car's running speed is too high, the car may not be able to adjust the direction and may deviate from the established track, so the motor cannot be fully stable. speed at all times, which requires speed control of the trolley to perform certain functions. PWM speed control is the simplest and most popular method of speed control of today's motors.

The axis of the R/C servo motor is positioned using a technique called pulse width modulation (PWM). In this system, the servo is the response of a steady stream of digital pulses. More specifically, the control circuit is the response of a digital signal whose pulses vary from 1 to 2 ms. These pulses are sent out 50 times/second. Notice that it is not the number of pulses per second that drives the servo but the length of the pulses. Servo requires about 30 – 60 pulses/second. If this number is low, the accuracy and power to maintain the servo will decrease. With a pulse length of 1 ms, the servo is driven to rotate in one direction (say clockwise).

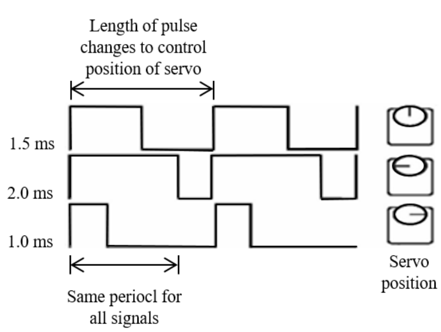

Figure 10: Controlling the position of the motor output shaft by pulse width modulation

With a pulse length of 2 ms, the servo rotates in the opposite direction. This technique is also known as digital ratio - the motion of the servo is proportional to the control digital signal.

The power supplied to the motor inside the servo is also proportional to the deviation between the current position of the output shaft and the position it needs to be. If the servo is near the target position, the motor is driven at low speed. This ensures that the motor does not exceed its intended destination. But if the servo is far from the destination position, it will be driven at full speed to reach the destination as quickly as possible. When the output shaft reaches the desired position, the motor decelerates. This seemingly complicated process takes place in a very short amount of time - an average servo can rotate 60 degrees in ¼ - ½ second. Since the pulse length can vary by manufacturer, the servo and radio receiver must be selected from the same brand to ensure compatibility. For the robot, we have to do a few experiments to determine the optimal pulse length.

4.4 Engine transmission module

As for the general robot with intelligent tracking and obstacle avoidance, it is mainly four-wheel drive, but the design uses a dual-drive type, and the tail has a guide wheel, one for each wheel. Both carry an engine to drive. It is also provided with a port that can be used to control the input/output of the motor and can be used to control the rudder. In this modular design, the core content is the motor drive chip and two DC motors, which can realize the Automatic Control of intelligent cars. It mainly receives commands from a specific node module, parses the data by Arduino, then passes the parsed instructions to different motor control chips, which can then control the state running of smart cars.

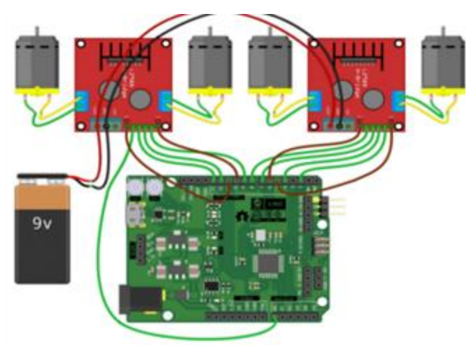

Figure 11: Connecting Arduino with 2 L298 modules

5. Conclusion

In this paper, the designed obstacle avoidance robot is considering intelligent tracking, obstacle avoidance and safety improvement, while providing verification and feasibility for intelligence realization. future unmanned intelligence and the overall function from hardware to software has also been realized, this system will have

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very important significance and reference value for the research and industrialization of automobiles. future smart cars.

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