A Study of WIFI Control Wheeled Robot System with Ultrasonic Obstacle Avoidance

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***Abstract*--With the progress of science and technology, wheeled robots have been widely used in various fields to help people complete tasks. However, when performing a task, the robot and the object could be damaged if the robot collides with the object due to negligence of the operator. Therefore, the safety issue is the most important consideration. This paper presents a multi-function system, including Arduino controller, rotary ultrasonic obstacle avoidance and WIFI control system. Red warning led and buzzers on the fuselage will alert operators in time of danger and feedback warning information to the phone. The system is proved to be feasible by experiment.**

Keywords--Wheeled robot, Arduino, Rotary ultrasonic sensor, WIFI.

I. INTRODUCTION

Nowadays, the design and control of mobile robot is still an important part of robot field. Mobile robot is small in size, light in weight and easy to carry, and has great potential in detecting environment in [1], [2]. For example, multiple fixed ultrasonic sensors are used to capture the environment information around the robot in [3]; Through WIFI control, infrared sensors are used to scan and avoid the surrounding obstacles in [4]. A multi-function wheeled robot system with rotary ultrasonic obstacle avoidance and WIFI control is presented in this paper. The system has the advantages of low cost and simple operation. The rotary ultrasonic sensor can detect obstacles in front and enable the robot to have obstacle avoidance. Compared to Bluetooth [5] and Infrared module, communication range and the reaction speed of WIFI is larger and faster, which is suitable for the control of middle and long distance.

II. ARCHITECTURE

A. *Hardware Architecture*

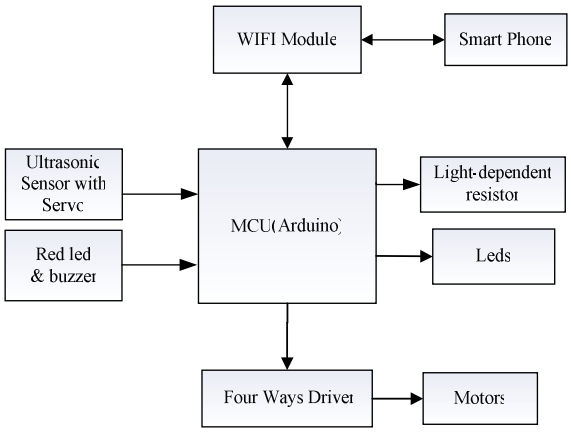


Fig.1. Hardware architecture of the wheeled robot

The Hardware architecture of the wheeled robot is shown in Fig.1.

1. Arduino UNO: Open source and cheap.
2. WIFI module: Arduino via ESP8266WiFi module feedback information to the mobile phone, and the mobile phone sends orders to the robot.
3. Motor drive module: Four-way drive module with L298N uses the PWM signal from Arduino to control the speed of dc motor.
4. Obstacle avoidance module: Obstacle avoidance module is mainly composed of HC-SR04 ultrasonic sensor, SG90 steering gear, red led and buzzer. The steering gear combined with ultrasound can detect obstacles in the range of 180 degrees.
5. Illumination module: When the light is dim, MCU uses information of 5539 light-dependent resistor to flash leds of two sides and light leds in the front of robot.

B. *Software Architecture*

(a) Ultrasonic obstacle avoidance

The wheeled robot can receive, update and save the measured distance of the ultrasonic sensor to determine the obstacle. The ultrasonic ranging formula is as follows:

$$d = Vs * \frac{t}{2} \qquad (1)$$

Vs : The speed sound travels through the air.
t : The time from sending the pulse signal to receiving.
The obstacle avoidance flow chart is shown in Fig.2.

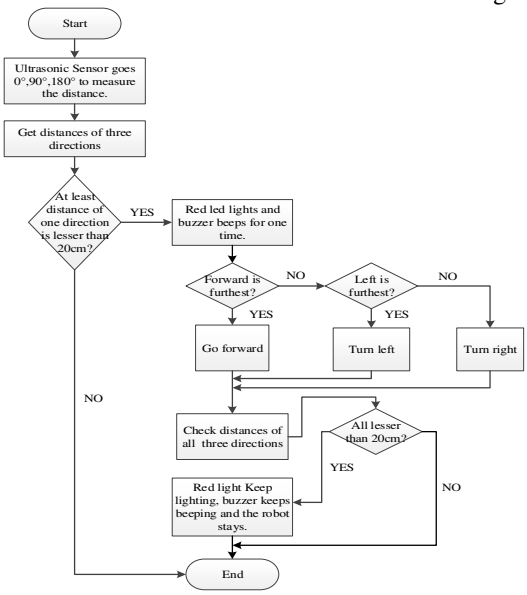


Fig.2. Flow chart of obstacle avoidance

Fig.2. shows that if obstacles in at least one direction of which distance to robot is less than 20 cm, red led will light, buzzer will beep for one time and the wheeled robots will get three directions (left, front and right) compared, select the further one, and turn to it. If the obstacle is still in 20 cm (when getting into a U type crossroad), red led will keep lighting, buzzer will keep beeping and the robot stays.

(b) WIFI control

Flow chart of WIFI control is shown in Fig.3. The mobile phone software establishes a connection with Arduino through WIFI module and then sends the following control orders to complete various actions.

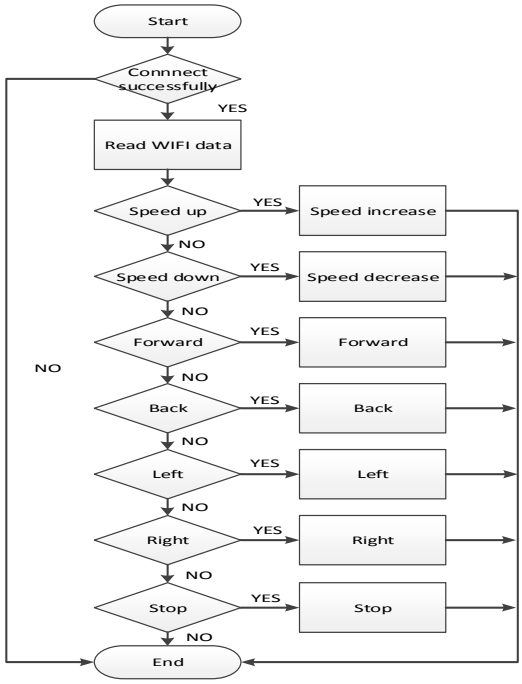


Fig.3. Flow chart of WIFI control

Forward/back: Make the wheeled robot forward/backward at speed v.

Turn left/right: Turn the wheeled robot to the left/right.

Speed up/Speed down: Increase/decrease the speed v a constant value.

Stop: Stop the wheeled robot.

III. EXPERIMENTAL RESULTS

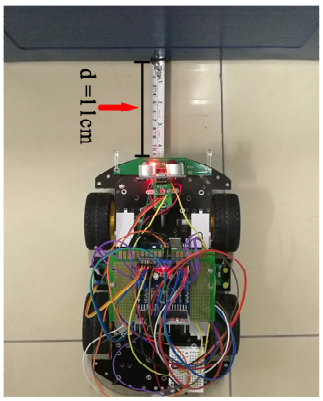
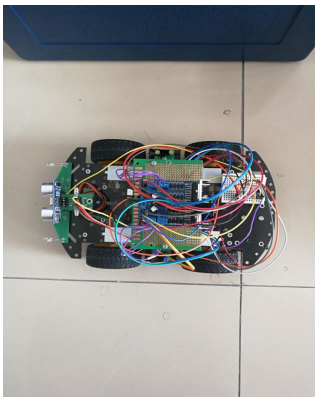


Fig.4. (a) Having detected the obstacle



(b) Avoid the obstacle

As shown in Fig.4(a), the wheel robot finds that the distance between the robot and obstacle is less than 20cm, red led lights, buzzer beeps for one time. Then turn to the furthest direction (left) to avoid obstacle as shown in Fig.4(b).

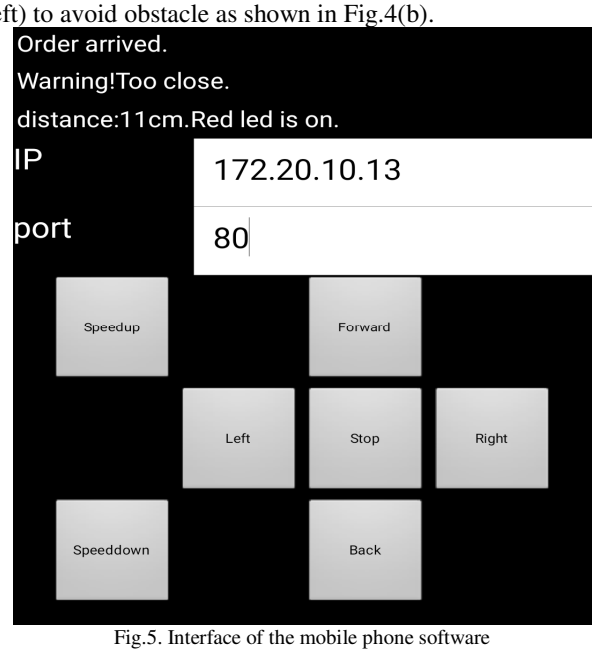


Fig.5. Interface of the mobile phone software

Fig.5. shows the interface of the mobile phone software. The mobile software receives the distance information between the wheeled robot and the obstacle, as show it and gives the operator a warning message when the distance is less than 20cm.

IV. CONCLUSION

This paper presents a safe wheeled robot control system using rotary ultrasonic sensor. Based on the traditional obstacle avoidance system, this system which combines warning module expands the application prospect. In the future, the system can be applied to the entertainment in the family life and the hidden lighting exploration work at different levels.

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