# Implementation of an Arduino Obstacle Avoidance Car for Automatic Drawing a Path Map

Yu-Huei Cheng*, *Member, IAENG*, Dan-Feng Wu, Xin-Yue Wu, and Dai-Hua Zhang

***Abstract*—This study implements an Arduino obstacle avoidance car and provides automatic path map drawing function. The L298N is used as the driving circuit, the PWM output from the Arduino is used for speed control, and the infrared sensor is used to emit infrared rays at a certain frequency to detect obstacles, and all the detection signals are sent to the Arduino. The Arduino acts as a control core to change the speed and steering of the car to achieve automatic obstacle avoidance. In addition, through the NodeMCU as a server, the PC is connected to the NodeMCU as a client, and then the data is transmitted through the socket connection, and the obtained data is drawn into a path map by Unity, thereby realizing the real time transmission function of the path map.**

***Index Terms*—Arduino car, automatic path map drawing, automatic obstacle avoidance, NodeMCU, Unity**

## I. Introduction

With the development of science and technology, the application of intelligent robots has been in the fields of machinery, electronics, metallurgy, transportation, aerospace, defense and so on [1-5]. In addition, in recent years, the intelligent level of robots has been continuously improved. In the process of constantly exploring, transforming, and recognizing nature, it is always a human dream to manufacture machines that can replace human labor. As a new product of modern society, intelligence is the future development direction. It can operate automatically in a specific environment according to a preset mode. Without human management, it can accomplish the desired or higher goals.

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In scientific exploration and emergency rescue, it is often necessary to detect some dangers or areas that humans cannot directly reach, which needs to be done by robots. Automated obstacle avoidance when robots travel in complex terrain is an essential and essential function. Therefore, the development of automatic obstacle avoidance systems has emerged. The automatic obstacle avoidance car was developed based on this system. It can be used as a regional exploration robot and an emergency rescue robot's motion system, allowing the robot to automatically avoid obstacles while traveling [6, 7].

This study mainly realizes the intelligent mode of the Arduino obstacle avoidance car. The car can transmit the path map in real time while driving, and then transmit it to the PC through Wi-Fi ESP8266 [8], which can make the surrounding environment more intuitive reflected. The designed theoretical scheme, analysis method, characteristics and innovations can have certain reference significance for the design of automatic semi-automatic robots such as automatic transport robots, mining exploration robots and household automatic cleaning robots. At the same time, this automatic drawing car can be used as a development object of household cleaning robots, and realizes economic benefits and forms commercial value when smart homes gradually become a trend.

The most attractive prospect of this automatic drawing path car is the environment that can be used to explore dangerous areas. In the event of fire or poor geological environment, such an automatic drawing path car design can reflect its role. It was able to map out a map of the time and find obstacles for rescuers to search. Such an automatic drawing path car also has broad application prospects in the investigation of the probe car. During the inspection, there are many dangerous places that people can't touch. At this time, the automatic drawing path car can come in handy. If you put a camera on it, you can do a lot of work that can't be done instead of people.

## II. Methods

At present, the cars on the market can be distinguished according to their functions as follows:

(1) Intelligent obstacle avoidance car: When obstacles are encountered, obstacles can be automatically avoided.
(2) Automatic tracing car: Through the tracking sensor, the automatic inspection function is realized.

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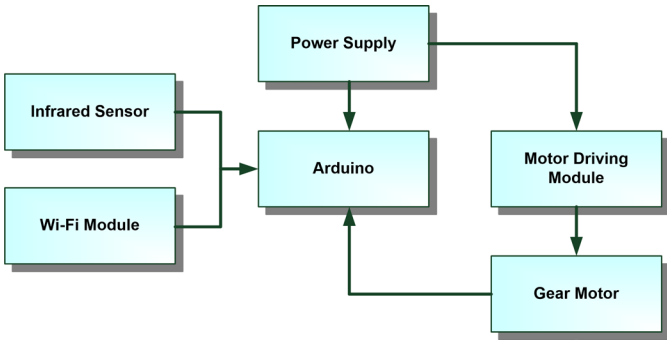


Fig. 1. Core hardware design.

(3) Automatic following the car: Through the infrared obstacle avoidance sensor, it can realize automatic following or obstacle avoidance function.
(4) Wi-Fi control car: Wi-Fi can monitor video in real time and control the movement of the car.

This study mainly realized an Arduino intelligent obstacle avoidance car and provided the function of automatically drawing maps. The design method is explained below.

### A. Design of Automatic drawing car

The automatic drawing car is mainly composed of Arduino, power circuit, motor drive, infrared sensor and Wi-Fi module, as shown in Fig. 1; its core hardware entity is shown in Fig. 2. The power supply is connected to the Arduino to power the entire car. The car uses the Arduino as the control core, and the steering of the car is realized by connecting the motor driving plate to control the speed of the reduction motor. The infrared sensor senses the road condition to confirm the road condition, and uses the Wi-Fi ESP8266 module to transmit data to the PC to draw the path in real time, until all the paths are traversed and the path map is drawn, thereby realizing the drawing path map function.

### B. Underbody design

In order to realize the automatic drawing path car, we designed the underbody (as shown in Fig. 3) and generated it with a 3D printer. The underbody description is as follows:

1 to 4: Used for an Arduino control board.
5 to 8: Used for a mounting L298N driving motor.
9: Used for an infrared sensor.
10: Used for an installed speed sensor.
11 to 14: As a height increase, use a DC gear motor.

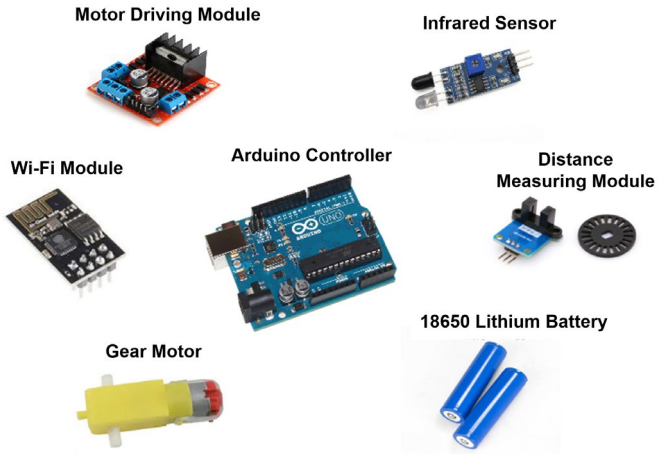


Fig. 2. Core hardware components.

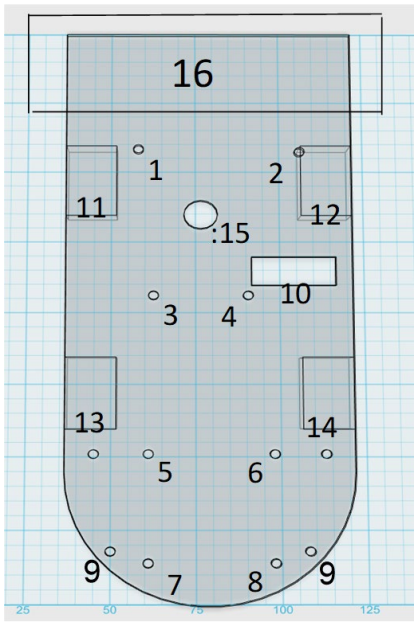


Fig. 3. Underbody design.

15: Connect the motor through the board.
16: The location where the battery is installed.

### C. Implementation of Arduino automatic drawing car

Table 1 shows the parts list of the Arduino obstacle avoidance car. We prepared some hardware according to the needs of the car design, and formed a basic obstacle avoidance car, which used the Arduino UNO as the main control board and used the infrared sensor as the obstacle avoidance detection.

The Arduino control board used has the following features:

(1) Open source code circuit design, program development interface free download, can also be modified according to your needs.
(2) Using a low-cost microprocessor controller (AVR series controller), it can be powered by USB interface, no external power supply, or external 9V DC input.
(3) It can be easily connected to sensors, a wide range of electronic components (e.g. infrared, ultrasonic, etc.).
(4) Arduino allows us to quickly integrate with Unity to make interactive works. Arduino can use existing electronic components such as switches or sensors or other controller components.
(5) Arduino's IDE interface is based on open source code

TABLE I
ARDUINO OBSTACLE AVOIDANCE CAR PARTS LIST

| PART NAME | Quantity |
|---|---|
| Arduino UNO | 1 |
| Gear motor | 4 |
| Tire | 4 |
| L298N motor driver | 1 |
| Infrared sensor | 4 |
| Mini breadboard | 1 |
| 18650 lithium battery | 2 |
| USB cable | 1 |
| DuPont line | several |
| Copper column | several |
| 3MM screw/nut | several |

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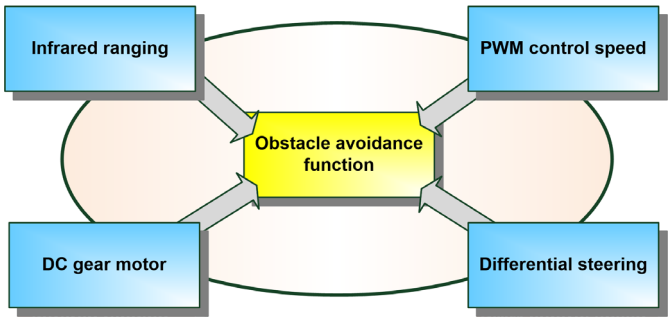

Fig. 4. Intelligent obstacle avoidance function.

and allows us to download and use it for free.

(6) USB interface, no external power supply required. There is also a 9V DC power input.
(7) In terms of applications, you can combine other development software to get out more interesting things.

*Obstacle avoidance function*

The obstacle avoidance function is shown in Fig. 4. The user can realize the automatic obstacle avoidance function of the car without having to control the car. The infrared ranging enables the car to determine the behavior of the car through the infrared sensor during the driving process, and the DC gear motor makes The car can walk smoothly, use PWM to control the speed of the car, and use differential steering technology to enable the car to achieve steering by controlling the speed of the left and right drive wheels. When the driving wheel speed is different, the body will rotate even if no steering wheel or steering wheel does not operate.

*Automatic drawing path function*

The automatic drawing path function is shown in Fig. 5. Automated drawing path uses NodeMCU [9] as the receiving data and uses the right-hand rule to achieve a complete traversal of the enclosed area. In order to receive data and perform judgment processing at the same time, we use ProtoThreads to implement Arduino multi-thread process and use raster encoder to measure distance.

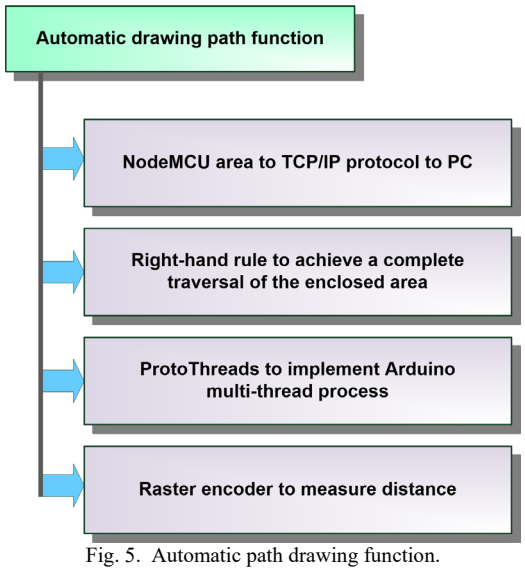

Fig. 5. Automatic path drawing function.

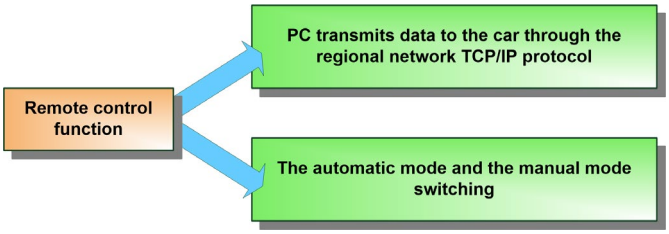

Fig. 6. Remote control function.

*Remote control function*

The remote control function is shown in Fig. 6. The user can remotely control the behavior of the car, use the PC to transmit data to the car through the regional network TCP/IP protocol, and can switch between the automatic mode and the manual mode.

## III. Results and Discussion

This study uses Arduino IDE 1.8.0 and writes C/C++ program to complete the movement and control of the Arduino obstacle avoidance car. In order to clearly present the path map drawn, we use the Unity to develop user interface to receive data from the Arduino obstacle avoidance car. In order to detect obstacles, we have four infrared sensors on the front of the car body to sense the left and right obstacles. The Arduino obstacle avoidance Wi-Fi module and the L298N are also placed in the front part of the car, with the Arduino microcontroller in the middle, the battery installed at the rear of the car, and the DC geared motor placed under the car body on both sides. And in one of the DC geared motors is equipped with a distance measuring module, the overall realization of the Arduino obstacle avoidance car shown in Fig. 7 and Fig. 8.

This Unity user interface has four buttons: connect the car, start drawing, turn off the car, and clear the map. After the user presses the button to connect the car, the car will be connected to the WI-FI to prepare for path drawing. After clicking to start drawing, the car will start drawing path. When the user sees that the car has finished all the routes, he

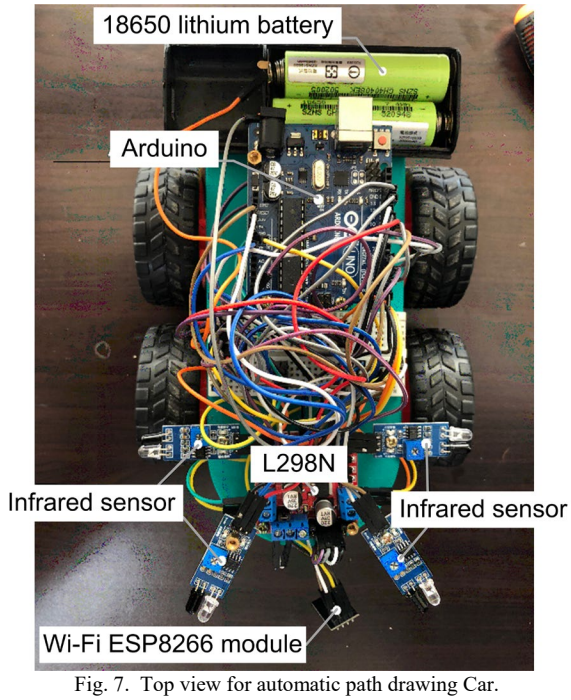

Fig. 7. Top view for automatic path drawing Car.

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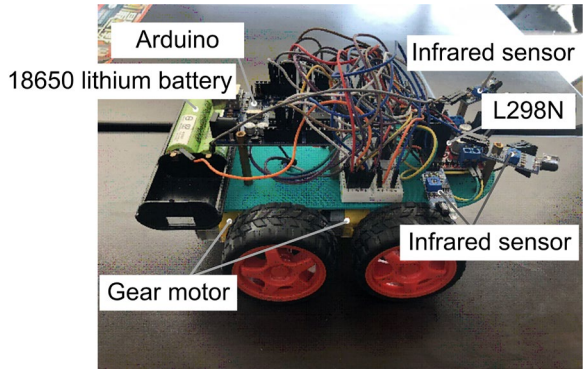

Fig. 8. Side view for automatic path drawing Car.

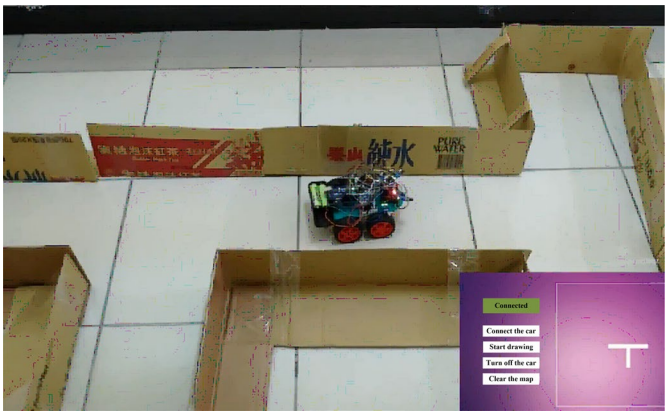

Fig. 9. User interface and actual automatic path drawing car driving.

can click to turn off the car. You can click to clear the map the next time you use it or when you want to draw a new path map, and let the car go again (as shown in Fig. 9).

The automatic drawing car developed by the institute realizes obstacle avoidance and path map drawing functions. The car system can set the minimum safety distance, and can also adjust the running speed of the car. When the distance between the car and the obstacle is less than the safety distance, the driving motor will change the direction of the car, thereby achieving the effect of obstacle avoidance. Our car can traverse the maze and automatically send the path map to the client. In the future, we can set up a micro server to upload the data to the server. After that, all the people who need it can download the path map directly through the internet server to realize the real IoTs. The features of the automatic path drawing car are explained below:

(1) The drawing path map algorithm can be embedded in existing robots to make the robot more intelligent.
(2) The path drawing map car can be applied to the exploration of dangerous and unknown areas, and in the area where humans cannot search.
(3) The path drawing map car can transfer the map to the APP and PC in real time, and achieve the function of instantly viewing the unknown environment.

## IV. Conclusion

The intelligent car is a miniaturized robot that can perform specific tasks through intelligent means. It has the advantages of low production cost, simple circuit structure and convenient program debugging. Thanks to its strong practicality, the intelligent car is popular among robot lovers and factories. It can be applied to home cleaning robots and exploration of dangerous areas. In this study, the Arduino is used as the control core of the obstacle avoidance car, and the information and communication technology is used to realize the path map drawing function. Although the developed path drawing car can realize the obstacle avoidance and path map drawing function, the path drawing car is still in a simple foundation stage, and further expansion and deepening are needed. The main improvements are suggested to use more advanced components to sense obstacles at long distances. At the same time, it is also possible to add clean green energy-saving solar cells instead of battery blocks, and to provide a more beautiful car body design.

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