Communication Stability Experiment of IOT Car Based on WIFI and Bluetooth

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Abstract

This works uses ordinary smart cars as an experimental platform, driving dual DC motor with L298N. Real-time monitoring the car's speed and transmit speed information to Android mobile terminal through multiple IOT technologies. At the same time, the mobile phone sends control information through APP to control the speed of the car. The communication methods between the car and the mobile phone include Bluetooth communication, the WiFi module connects the route to communicate with the mobile phone and the WiFi module communicates with the mobile phone directly in hotspot mode. By comparing the transmission distance and communication stability of various IOT modes, the best IOT communication mode can be selected. Integrate various control functions into the mobile phone and make full use of the mobile phone terminal for development. The research scope includes the programming of MCU software, the acquisition and transmission of car speed, the programming of mobile phone software, the design and implementation of Bluetooth information interaction and the realization of TCP/IP and MQTT communication.

Keywords

Android; WIFI; Bluetooth; IOT; Smart car; Communication stability.

1. Introduction

With the popularity of household appliances and the promotion of smart home, people rely more on household appliances and the functional requirements of the appliances are further increased. More and more people hope to use a variety of appliances through remote control. At the same time, the use of smart phones is not only very popular, but almost everyone is always taking the phone with them, using the phone to control the electrical appliances in daily life [1], so life will become more convenient and fast. Using mobile APP to control household appliances must first solve the problem of communication between mobile phone and various electrical appliances. Only through stable information exchange can household appliances work accurately. In the past, the most common communication methods were infrared remote control and Bluetooth remote control. Now almost all households have wireless routers, making it possible for household appliances to communicate with mobile phones through WIFI. This design takes the smart car as the platform, controls the smart car by using Bluetooth and WIFI on the mobile phone at different distances and obtains the actual movement of the car in real time. The stability of different communication modes is analyzed through the comparison of multiple sets of data.

2. The Overall Design of the System

The goal of the design is to communicate with the Upper-Computer by wireless means using mobile phone software, so as to control the movement of the car, collect the speed, temperature and real-time movement of the car. The system is inclide three parts: mobile phone software APK, trolley control programming, hardware design. The monolithic computer on the car controls the motor driver to realize the positive and negative speed of the motor and completes all kinds of motion functions of the car, and sets up the mobile phone interface to complete the setting of motion functions of the car. After the Bluetooth module HC-06 or ESP8266 WiFi in the car communicates with the mobile phone, it can receive various instructions from the mobile phone. Next, the received instructions are transmitted to the MCU for analysis and processing, according to the different instructions jump to the corresponding subroutine to control the motor drive, so as to complete the different operation of the car, and the real-time motion information of the car is sent back to the mobile phone interface [2].

To test the maximum distance between the mobile phone and the car, three different environments were selected for the experiment: 1) in a open space; 2) Barrier with doors; 3) b Barrier with walls.

2.1 Experiment Steps

2.1.1 Bluetooth Control

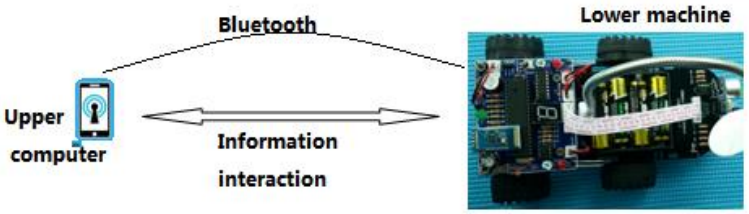

Fig. 1 Bluetooth control

The MCU is connected with the mobile phone Bluetooth by the Bluetooth module HC-06. The MCU in the car controls the motor driver to realize the positive and negative speed of the motor and completes the various motion functions of the car [3].

The mobile phone sends a command to the car randomly every 3 seconds through Bluetooth. After receiving, the car adjusts the motor speed and movement function. The actual information of the car is measured and recorded on the display screen by encoder. At the same time, it is sent to the mobile phone through Bluetooth. The error of information exchange is calculated by comparing the transmitted data with the received data. At the same time, the time interval between sending and receiving messages is recorded.

Increase the distance between the mobile phone and the car by 5 m each time and stay at that position for 3 minutes to collect 60 times of data, calculate the average value, draw a broken line map.

2.1.2 ESP8266 Connects to the Mobile Phone Through a Hotspot

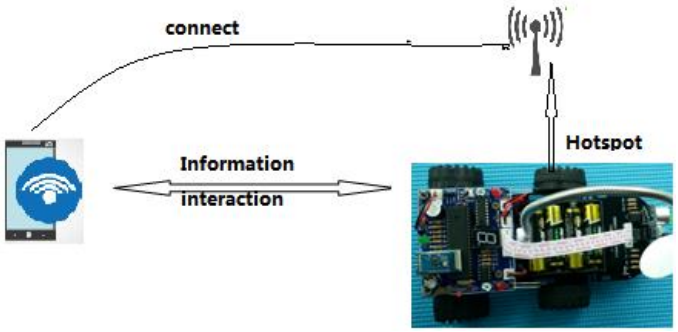

Fig. 2 ESP8266 connects to the mobile phone through a hotspot

The MCU opens the hotspot through ESP8266, and the mobile phone connects the hotspot to establish a LAN; the other steps are the same as the Bluetooth control [4].

2.1.3 ESP8266 Connects to the Mobile Phone Through a Router

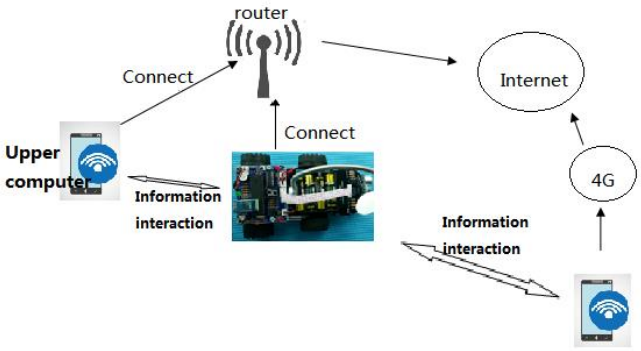

Fig. 3 ESP8266 communicates with mobile phone by router

Setting up MQTT server in the computer. The MCU establishes the MQTT client through ESP8266 and connects to the Internet through router. The mobile phone establishes the MQTT client through Android software and connects to the Internet through 4G network to exchange information between the MCU and the mobile phone [5].

Increases the distance between MCU and router by 5M each time, and the other steps are the same as the Bluetooth control scheme.

3. Experimental results

3.1 Experimental data

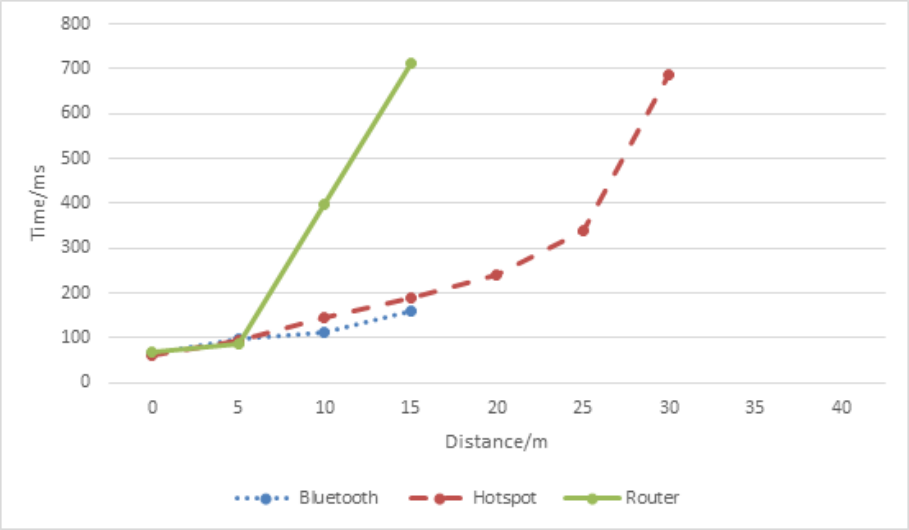

Fig. 4 Communication distance without barrier

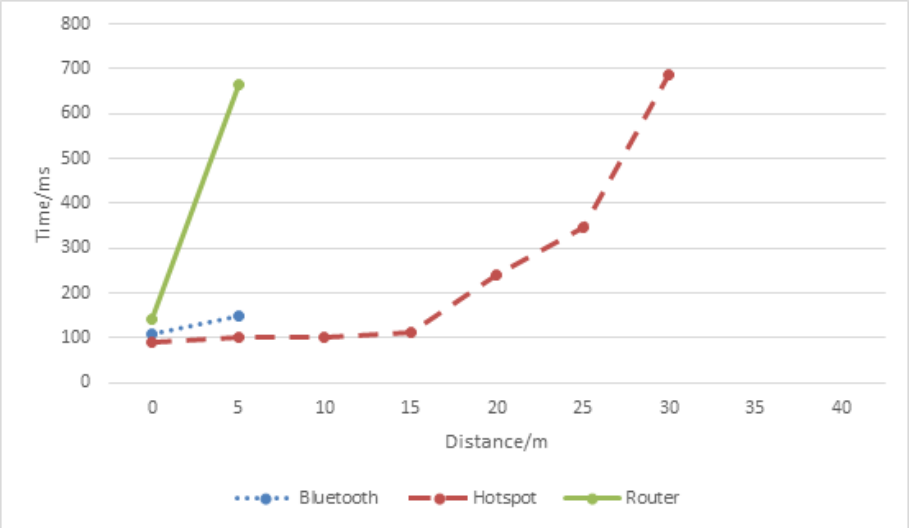

Fig. 5 Communication distance when there is a door barrier

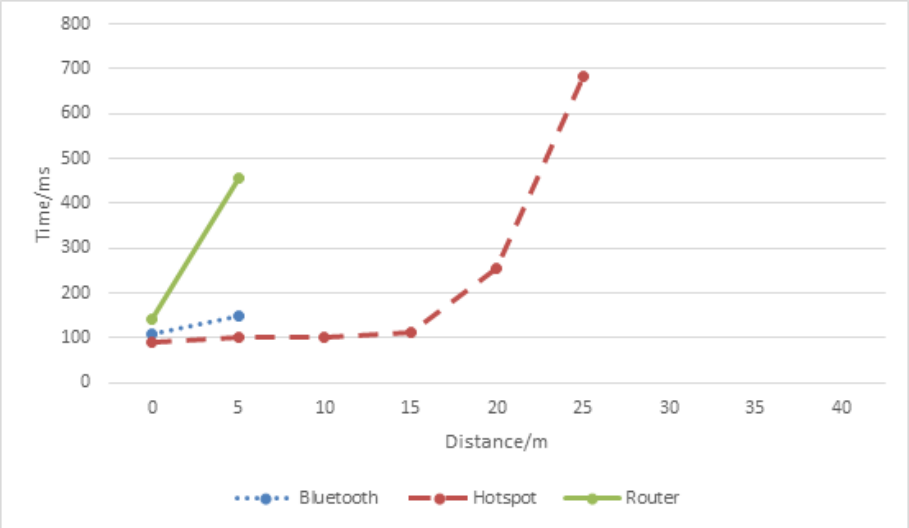

Fig. 6 Communication distance when there is a wall barrier

3.2 Experimental Analysis

(1) The control error of the 3 communication modes is equal.

(2) If no barrier, the Bluetooth mode disconnects after exceeding 15m, and the maximum response time is 0.15s; The ESP8266 hotspot mode is disconnected at more than 35m distance, but its maximum response time is 0.65s;the mode of communicate with router is disconnected at more than 15m distance, but its maximum response time is 0.43s.

(3) If the signal is blocked by the door, the Bluetooth mode disconnects after exceeding 5m, and the maximum response time is 0.15s; The ESP8266 hotspot mode is disconnected at more than 30m distance, but its maximum response time is 0.68s;the mode of communicate with router is disconnected at more than 10m distance, but its maximum response time is 0.66s.

(4) If the signal is blocked by the door, the Bluetooth mode disconnects after exceeding 5m, and the maximum response time is 0.15s; The ESP8266 hotspot mode is disconnected at more than 25m distance, but its maximum response time is 0.68s;the mode of communicate with router is disconnected at more than 10m distance, but its maximum response time is 0.71s.

4. Conclusion

The experiment completed the comparison of the longest communication distance and the stability of the three IOT modes under different barrier objects. Based on the experimental data, it is concluded that:

The effective communication distance of the mode of Bluetooth control Communicate with router is the shortestthe ESP8266 hotspot mode has 3 times the LAN area compare to the first two.

Under the longest effective distance, Bluetooth's response time is the fastest, ESP8266 hot mode response time is a little longer, ESP8266 connection routing mode response time is greatly affected by the network.

When the object is obstructed, the communication distance between the three modes is obviously shortened.

The experiment has several technical difficulties. The upper computer controls the movement of the car to require high real-time, and the acquisition of the car speed and dial display, which puts forward the stability of communication requirements, and for the inherent delay of TCP / IP communication is even more difficult [6]. The implementation of Internet communication can sometimes cause delay due to network problems, so the error can only be reduced by multiple experiments.

Acknowledgements

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