

## Design and Implementation of Mobile Car with Wireless Video Monitoring System Based on STC89C52

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**Abstract:** With the rapid development of wireless networks and image acquisition technology, wireless video transmission technology has been widely applied in various communication systems. The traditional video monitoring technology is restricted by some conditions such as layout, environmental, the relatively large volume, cost, and so on. In view of this problem, this paper proposes a method that the mobile car can be equipped with wireless video monitoring system. The mobile car which has some functions such as detection, video acquisition and wireless data transmission is developed based on STC89C52 Micro Control Unit (MCU) and WiFi router. Firstly, information such as image, temperature and humidity is processed by the MCU and communicated with the router, and then returned by the WiFi router to the host computer phone. Secondly, control information issued by the host computer phone is received by WiFi router and sent to the MCU, and then the MCU sends relevant instructions. Lastly, the wireless transmission of video images and the remote control of the car are realized. The results prove that the system has some features such as simple operation, high stability, fast response, low cost, strong flexibility, widely application, and so on. The system has certain practical value and popularization value. *Copyright © 2014 IFSA Publishing, S. L.*

**Keywords:** STC89C52, Camera, Android software, Wireless video car.

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### 1. Introduction

With the rapid development of wireless networks and image acquisition technology, the wireless network video monitoring system plays a more and more important role in public security, home security, dangerous environment remote monitoring etc. Most of the traditional video monitoring usually use wired network. This leads to some questions such as network cabling complexity, the greater influence caused by the layout and environmental, and the higher cost caused by relatively large volume. According to various requirements, wireless video monitoring has gradually become the mainstream

of the market [1-6]. The transmission data quantity of the toll-free wireless network is little, so it is not suitable for transmitting image signal. In recent years, with the rapid development of embedded technology [7-17], we propose a method that the mobile car can be equipped with wireless video monitoring system for transmitting information through a router. The collected data by the camera is converted from the current transformation method of electromagnetic wave into the transmission method of WiFi router [18-23]. Thus, it is convenient for the control of the car and free camera for each user. From the user perspective, the design can let everyone access to human inaccessible region and camera in order

to get more accurate information. From the social development, each wireless video car can be changed into wireless reconnaissance vehicle. At the same time, the mobile phone is a portable object and not easy to find. Thus it can be used in dangerous and harsh environment such as combating illegal molecular, records of illegal evidence, military reconnaissance and anti pollution, and so on. Because of its special applications, this kind of car should have the advantages of simple operation, high stability, fast response, low cost, flexible movement, reliable and so on.

## 2. The Overall Design of the System

The overall design diagram of wireless video monitoring car is shown in Fig. 1. This system includes the host computer software, wireless router and image acquisition equipment, MCU system, power system and its drive circuit.

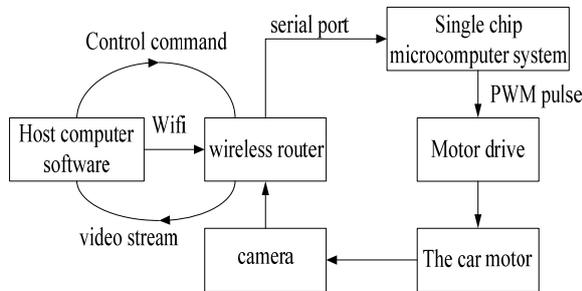


Fig. 1. The overall design diagram of the system.

This system takes the STC89C52 MCU as the control core. Wireless router which can connect USB camera is used as the image acquisition and transmission, information sending and receiving media. It transmit the real-time image information to PC (Linux PC, Windows PC, Android phone or Android tablet) which supports WiFi function, and then the returned image information by the PC software can be displayed, stored, compressed, etc. Distant monitoring personnel can grasp the real-time situation of the monitoring site based on this information.

In this MCU system, serial communication is used between MCU and the router, and then the command signal can be sent to MCU through a wireless router. MCU sends corresponding command to the car in order to achieve some functions such as forward, backward, turn left, turn right, and stop. At the same time, the video signal is send to PC, so that monitoring personnel want to get further access to information. If the wireless router is connected to the Internet, so that anyone in the world where a network can be identified by a unique IP address of the router can manipulate this monitoring car.

## 3. The Hardware Design of the System

The hardware of the system is mainly divided into four modules: master module, wireless transmission module, car module and client module. The relationship between each module is complex.

### 3.1. Master Control Module

Master control module is the core of the whole system. STC89C52 MCU has some characteristics such as abundant resources, run faster, cheaper prices, and so on. Therefore, this system with STC89C52 as the core processor can realize the function as follows: PWM motor speed control, receiving wireless and various kinds of sensor signals, accurate control of the wireless video car movement and the processing of monitor images. MCU is responsible for receiving a control command from the wireless router. The pulse signal of different duty cycle is analyzed in order to control motor speed. Two general-purpose I/O port of the MCU control the motor rotation direction as shown in Fig. 2.

TTL serial communication is used between the MCU and wireless router. Only two signal lines can complete the bidirectional communication. Therefore the circuit is simple and easy to control, and then fast and high reliability of information transmission is realized by TTL serial communication with the software calibration algorithm.

Serial port receives information in the interrupt mode. Compared to the query method, it takes up less CPU resources. So it can respond control command in the shortest time and enhance the real-time control.

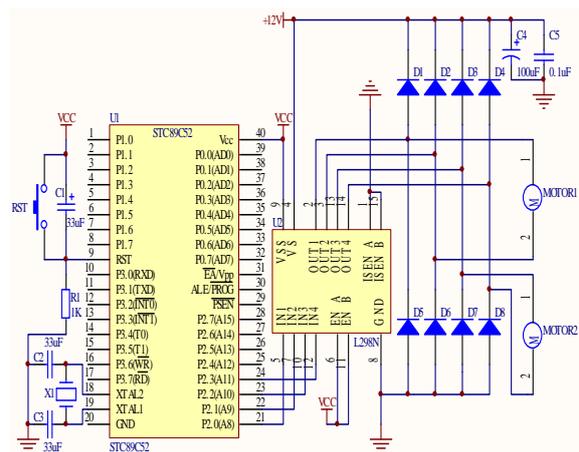


Fig. 2. The schematic of the MCU control the motor rotation direction.

### 3.2. Wireless Transmission Module

Smart small car is equipped with wireless router and camera, so it can detect the areas that are

unknown and dangerous to human, and send the image to PC for display, storage, and compression.

An important index of wireless router selection is that it must have the USB host interface which is used to connect a USB camera and serial port which is used to communicate with the MCU. The operating system of the wireless router is mainly OpenWrt operating system in the software. Compared with the original firmware, OpenWrt is not a single, static firmware, but to provide a writable file system that can be added software package. This user can freely choose the application program and configuration without equipment provider's limitation. For developers, OpenWrt is a framework, so developers can also get the application what they want without the entire firmware. Users can use the equipment in different ways.

The router's firmware version of this system has been installed with abundant device driver software, so it can identify most USB cameras on the market through a simple configuration. When the software is installed, it only needs to copy the software to the U disk and install through the command without having to reinstall the whole system. Therefore, it greatly facilitates debugging. In conclusion, we adopt mjpg-streamer as the video server in order to complete the image acquisition and install the corresponding upper layer application software on the router.

### 3.3. The Car Module

When four wheel car turns, differential speed cornering is need. Therefore, the MCU programming will take up more memory space. Based on the above reasons, the two wheel drive with a universal wheel is used. In motor driver circuit design, microcontroller PWM signal is sent into motor drive circuit through the opto-coupler in order to better achieve the isolation of the interference and reduce the interference signal which will cause serious influence on stable operation of the MCU and the router. BTS7970 is used as motor drive chip. This chip can ensure the continuous operation of the car for a long time because of strong current driving ability, less heat and high efficiency. 12 V rechargeable lithium battery as the power supply of the whole car can guarantee the normal work of the car in outdoor. The user control wireless emission module through the terminal operating system in order to realize the direction of motion and the state switch of the car.

### 3.4. Client Module

The image information collected from the scene by the wireless video car is transmitted to PC Client. Then PC Client can display, store and compress the returned image information by the PC software. At the same time, the client can control the car to perform forward, backward, turn left, turn right,

and stop, so that monitoring personnel want to get further access to information. Therefore, any platform that supports wireless WiFi can be used as a client, such as Linux PC, Windows PC, Android mobile phone and Android tablet. Wireless video monitoring system designed by mobile phone can be used in dangerous and harsh environment such as combating illegal molecular, records of illegal evidence, military reconnaissance and anti pollution, and so on.

## 4. The Software Design of the System

### 4.1. PC Software

The PC software was programmed by Java language. The designed software based on the android platform has good portability and operability.

The main functions of the PC software are receiving and displaying the image, and sending control commands in real time. The mobile phone screen background is image display interface of the system. In the mobile phone screen, some operation button such as forward, backward, turn left, turn right and stop are used to control the car movement. Display interface on the mobile phone screen is shown in Fig. 3.



Fig. 3. Display interface on the mobile phone screen.

### 4.2. The Software of Single Chip Processor System

The main task of the MCU software is receiving and parsing the control command, and then executing the command. Its development platform is Keil C51. We can get compact codes which are easily understood. These are conducive to the development of software for the user.

In the MCU software design, the command receiving program is put in the interrupt service program. Therefore, this will minimize the command receiving delay and prevent the loss of data. When the router sends data, the MCU generates the serial port interrupt and enters the interrupt service program. Data is received in the interrupt service program, and stored in the array. When a command is received, Rec\_flag which denotes the received command complete flag is set. When a command

whose length is 5 bytes is completely received, the command receiving sign Rec\_flag is set. In the main program, the loop body continuously checks Rec\_flag. When Rec\_flag is one, the received data is checked. If the command is invalid, it is discarded. And then the next cycle is entered. Otherwise, the corresponding action is executed. The flow chart of the main program and the serial port interrupt service program are respectively shown in Fig. 4 and Fig. 5.

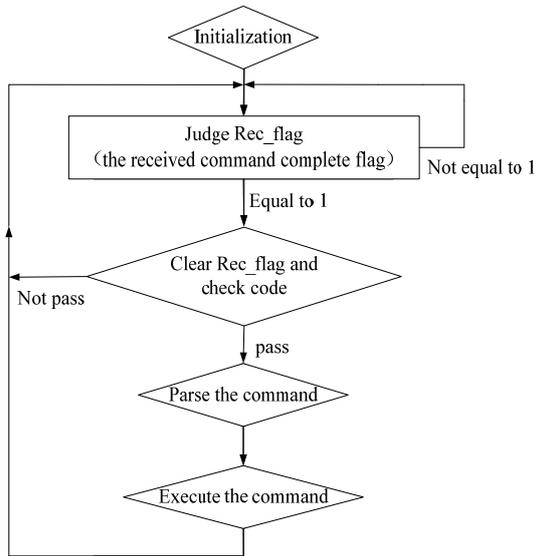


Fig. 4. The flow chart of the main program.

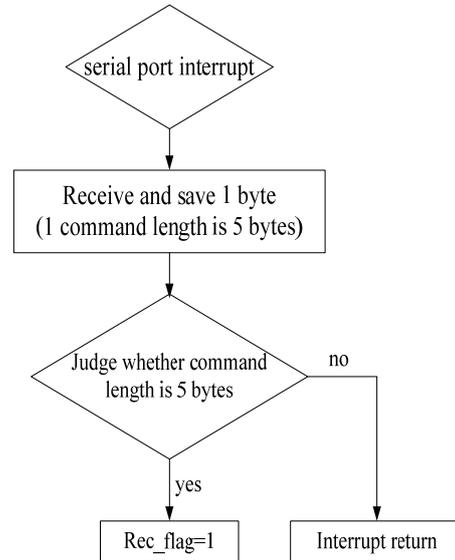


Fig. 5. The flow chart of the serial port interrupt service program.

## 5. Joint Test and Verify

According to the above design, wireless video car is designed as shown in Fig. 6. Firstly, the system is powered, and the wireless router is started. Secondly, the client interface is opened. Lastly, the test result of wireless video car is shown in Fig. 7. It can be seen from the Fig. 7 that the wireless video car can be taken a picture quickly and easily at each point.

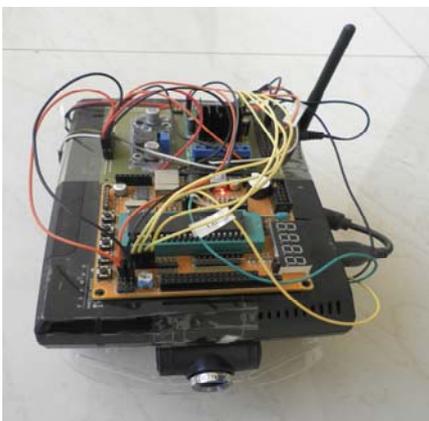


Fig. 6. Wireless video car.

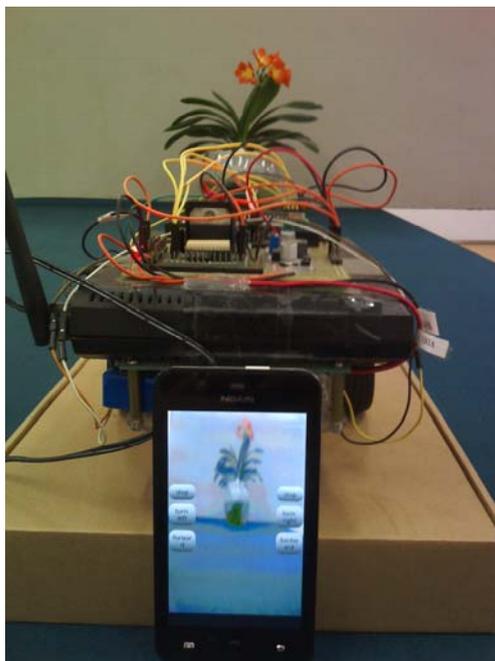
Mobile phone remote control car and let this car move to where it is needed shot, and then wireless transmission of video images and the remote control of the car can be realized so as to achieve the effect of on-site real-time monitoring. This provides a fast and convenient way of shooting for in-depth high-risk areas. If the wireless video car is slightly modified and fitted with the corresponding sensor, it is further applied in mining exploration, scientific rescue, anti stress, anti terrorist attacks and other fields.

## 6. Conclusions

The design of the wireless video car uses a relatively new concept. Instruction, signal and image are transmit by the wireless WiFi router transmission way. The wireless transmission of video images and the remote control of the car are realized. The system has some features such as simple operation, high stability, fast response, low cost, strong flexibility, widely application, and so on. Mobile phone as a personal terminal is small volume and more portable. The system has certain practical value and popularization value.



(a)



(b)

Fig. 7. The test result of wireless video car.

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