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THE DESIGN OF WIRELESS RESPONDER SYSTEM BASED ON RADIO FREQUENCY TECHNOLOGY

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ABSTRACT

Wireless responder system is more and more widely used in various fields, especially in voting systems. In this paper, STC89C51 microcontroller is used as the CPU for overall control in the design of the wireless responder system based on radio frequency technology.

KEYWORDS

Wireless responder system, 51 series single chip microcomputer, wireless module, liquid crystal display

1. INTRODUCTION

In recent years, with the rapid development of science and technology and wireless communication, the original transmission technology can no longer satisfy the needs of people, so the wireless forestalling-answer system comes into being [1-5]. The wireless forestalling-answer system based on the radio frequency technology is one of them.

2. SCHEME DESIGN

2.1 Scheme Demonstration

The transmission distance of Nrf24l01 wireless module can reach about 10 meters with 2.4G wireless technology of duplex transmission mode, strong anti-interference and low power consumption [6]. Consequently, it is better than 27MHz wireless technology in terms of anti-interference and power consumption. The theoretical value of data transmission rate of 2.4G wireless transmission technology is 2 times higher than that of Bluetooth, and the production cost of Bluetooth is higher. Using Nrf24l01 wireless module and 51 single chip microcomputers, namely, using 2.4G wireless technology to design a wireless response system [7].

2.2 The Principles of the System

This design is a wireless forestalling-answer system based on radio frequency technology with the LCD1602 display module, the reset circuit, and the clock circuit, and the system uses the STC89C51 single chip microcomputer as the control chip and Nrf24l01 wireless module as a bridge. The design is eight-routes rush-answer machine and includes two circuit boards, namely, a transmitting one and a receiving one. The voltage of the power supply is 5V [8]. The main operation is as follows. The first step is to turn on the power supply and reset, making sure the two parts are reset. Then, the answer time (0-99 seconds) should be set at the receiver. In the setting of countdown, one can select the appropriate option by pressing the eight-routes keys of the transmitter. Within the specified time, not pressing the button means wavier; pressing one time means approving; pressing two times means objecting. The corresponding voting results of the routes are shown on the display module of the receiving part [9]. The answer time and voting results are presented on display of the display module. Abstention, approval and objection are represented by 0, 1 and 2 respectively. No answer within the prescribed time is the default waiver.

3. SYSTEM HARDWARE DESIGN

3.1 The Structure and Function of STC89C51 Single Chip Microcomputer

STC89C51 single chip microcomputer (as shown in Figure 1) is composed of the central processing unit (CPU), memories and I/O connectors. The single chip microcomputer as one of the main parts of the design, it is essential to the whole design, acting as the program driver to realize all the functions and making the circuit work in a coordinated way. It has low power consumption and high performance, and it can also be used as a memory [10]. STC89C51 single chip microcomputer still uses the classic MCS-51 kernel, which is compatible with the instruction system of MCS-51 products and integrates a 4KB memory on chip. It can be repeatedly programmed / erased 1,000 times. This single chip microcomputer not only has all the basic functions of the old single chip microcomputer, but also has intelligent functions. It has characteristics of high integration, high speed, low energy consumption, small volume, and so on. It also has the clock circuit and the reset circuit. This new type of single chip microcomputer is very powerful and is able to be used for a variety of purposes. C language programs, downloaded to single chip microcomputer, and the surrounding circuit modules form a system of many functions and intelligence, making our lives convenient.

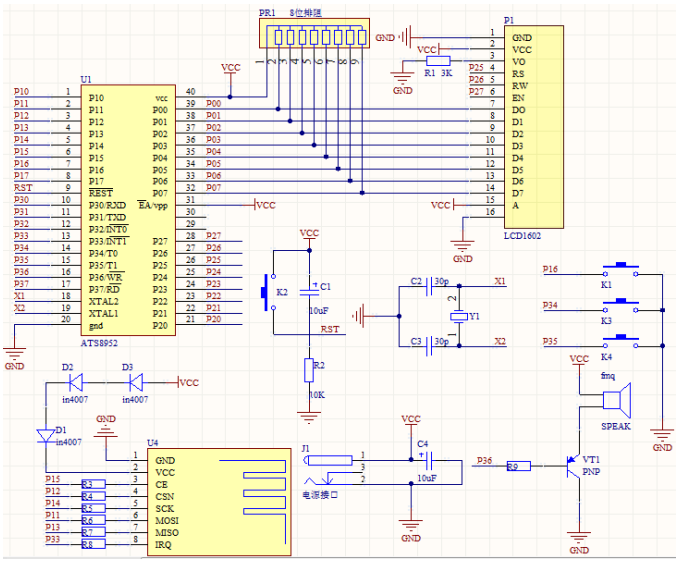

Figure 1: The Pin Structure of STC89C51 Single Chip Microcomputer

The pin structure diagram of STC89C51 single chip microcomputer is shown in Figure 1. As shown in Figure 1, it can be seen that 20 pin is the ground GND, and 40 pin (VCC) is the power supply [11]. The two pins are power pins.

3.2 External Crystal Pin

XTAL1 (pin 19) and XTAL2 (pin 18) constitute the external crystal pins.

They can form an oscillation circuit, a clock circuit and so on. Circuit modules and different electronic components have various function structures, which fully reflects the powerful and diverse functions of single chip microcomputer.

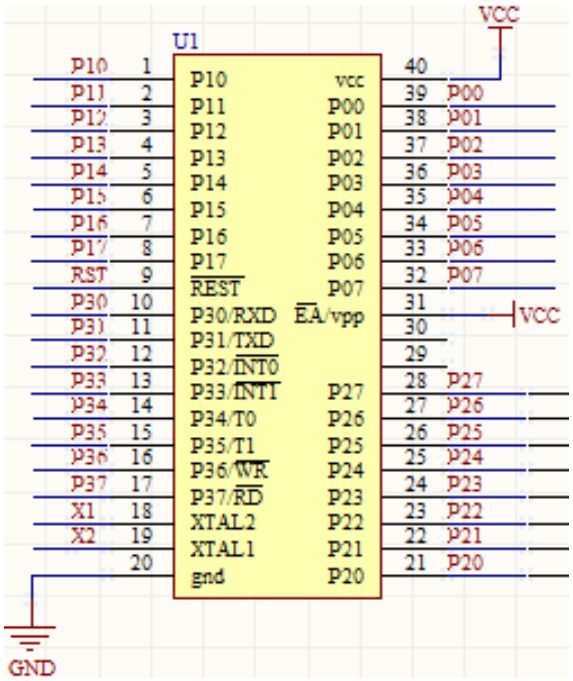

Figure 2: the STC89C51 Pin Diagram

As the Figure 2 shows, the two parts of the design both have reset circuits, allowing the circuit to work in a normal way. Reset circuits are the essential part of the design, in order to make the circuit of the system operate normally [12,13]. The function of reset circuits is to prevent single chip microcomputer from sending wrong instructions and performing erroneous operation. Power-on reset is an automatic reset of the circuit after connecting the power supply and keeps the default settings, so as not to make the circuit abnormal. The manual reset is made when the circuit completes an operation, or the circuit system becomes abnormal during operation.

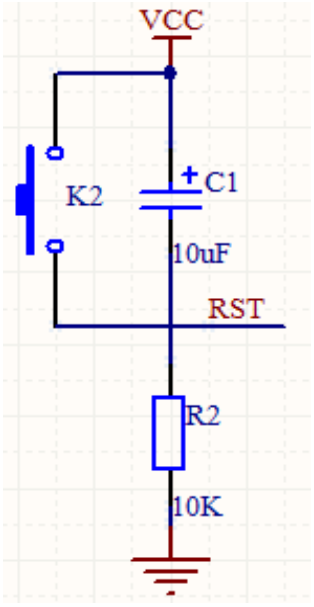

Figure 3: The Reset Circuit

The working principle of reset circuits is shown in Figure 3. Power-on reset works as follows. When VCC is powered up, the capacitor C1 is charged. The voltage appears on the 10K resistance, so that the single chip microcomputer is reset. After 10 milliseconds, the capacitor C1 is fully charged; the current on the 10K resistance drops to 0; the voltages also fall to 0. The single chip microcomputer enters the working state. During operation, the capacitor C1 discharges after pressing K2. The capacitor C1 is charged again when releasing K2 and the resistance has voltage, allowing the single chip microcomputer to be reset and enter the working state after 10 milliseconds [14]. This is how to operate manual reset.

3.3 The Clock Circuit of Single Chip Microcomputer

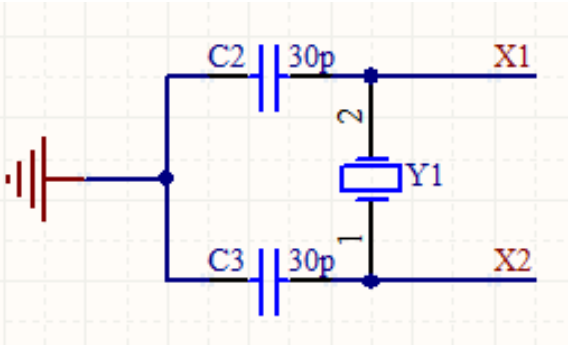

Figure 4: The Clock Circuit

The connection between input XTAL1 and output XTAL2 of STC89C51 single chip microcomputer is shown in Figure 4. The clock circuit of single chip microcomputer of the design is composed of X1 and X2. The ways of connections of the clock in single chip microcomputer can be divided into the internal clock mode and the external clock mode, according to different hardware circuits [15]. As shown in Figure 4, the internal clock mode is adopted in the design. The crystal oscillator Y1 in Figure 4 is to provide stable clock signals for the normal operation of single chip microcomputer. From figure 4, it can be seen that in the clock circuit, the two terminals of X1 and X2 are connected to the crystal oscillator Y1 and two capacitors (C2 and C3), forming an oscillation circuit. Figure 4 also shows that the capacitor value of capacitor C2 and capacitor C3 is 30pF.

The clock circuit in the design is to set up the time of answering and voting. The time range can be set between 0 and 99 seconds. It must be noted that responses and polls should be finished within the set time. The time cannot be set if it is beyond the time range. If actions are unable to be finished within the specific time, the time can be set manually.

3.4 NRF24l01 Wireless Module

The design uses the nRF24L01 wireless module as a bridge to transmit and receive radio frequency radio signals. There are two parts in the circuit, which are the transmitting part and the receiving part. The radio data is transmitted from the transmitting part, which is driven by single chip microcomputer. Similarly, the transmitted data is received in the receiving part

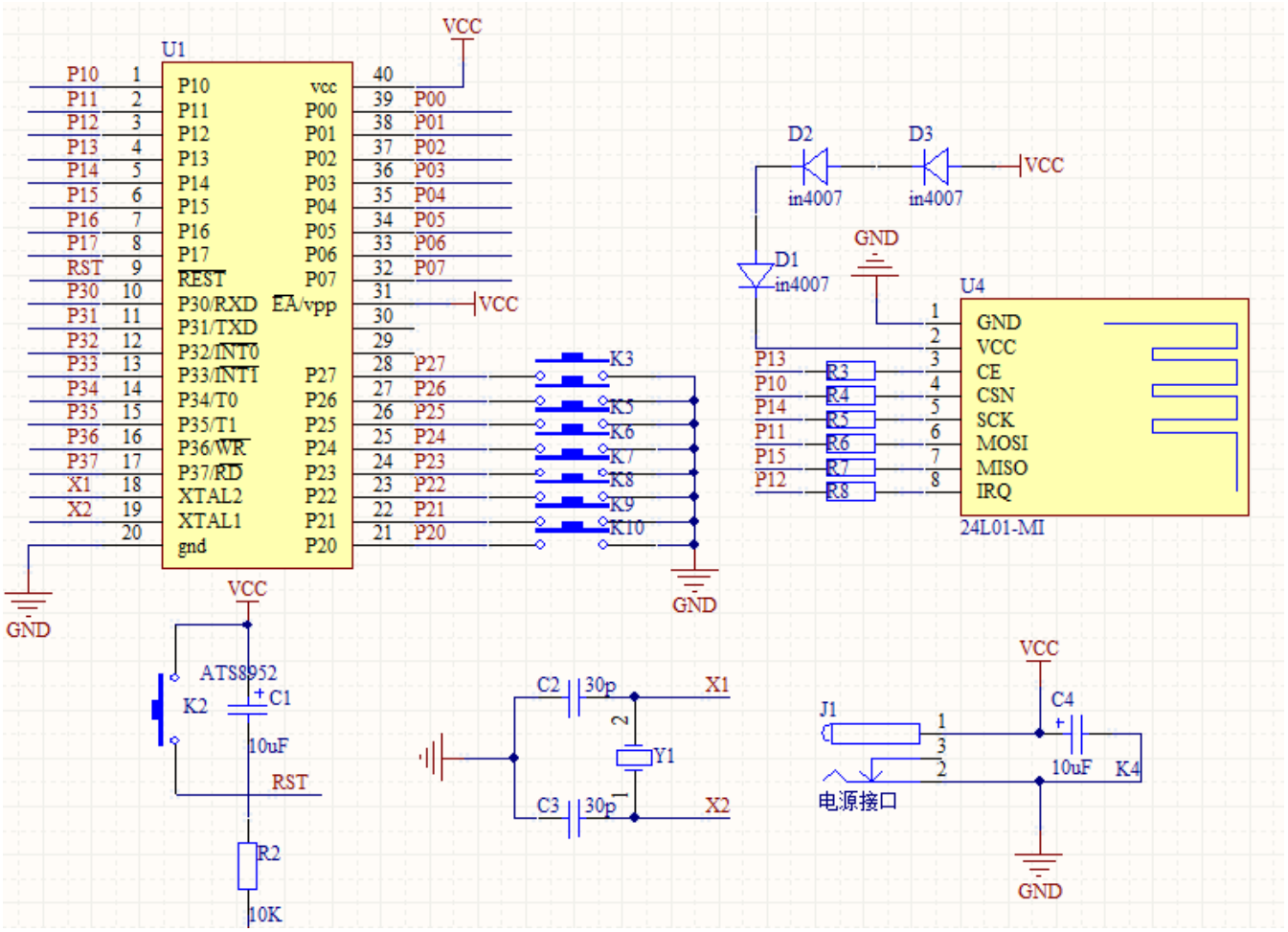

Figure 5: NRF24l01 Wireless Module

The nRF24L01 wireless module is a vital part of the design, as shown in Figure 5. NRF24L01 wireless module is a new single chip radio frequency transceiver of receiving and transmitting radio. Its working frequency band is between 2.4 GHz and 2.5 GHz, which is the globally open ISM frequency band supporting 2.4GHz, and the maximum transmitting power is 0dBm. The power consumption of nRF24L01 wireless module is low, and the working current is only 9 mA when the power of transmitting is -6 dBm. When receiving, the working current is only 12.3 mA, and the working voltage is 1.9-3.6V. Multiple working modes of low power make energy saving design more convenient, and there are four working modes, namely, transmit, receive, idle and power down modes. The normal effective communication distance is about 10 meters [16]. Whereas, an external antenna can be placed, so that its communication distance can be farther.

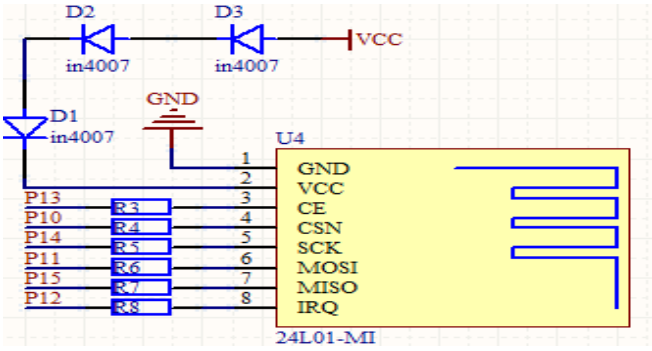

Figure 6: The Schematic Diagram of the NRF24L01 Wireless Module

4. CONCLUSION

The design of Wireless Responder System Based on Radio Frequency Technology has deepened my understanding of the AT89C52 single-chip microcontroller, including its development and prospects. It makes me more desired for the knowledge on this module.

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