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Design of Sickroom Wireless Call System

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Abstract

The system uses STC89C51 as the central part. It simulates the sickroom caller with keys, LCD1602 LCD display module, NRF24L01 wireless module and other auxiliary modules. Alarm circuit module and digital display module can make the receiver receive the signal effectively and can respond in the first time. A stable and efficient call system is designed, which has certain anti-interference ability and can realize multiple line calls without interference to each other. Each bed has a button, when press a button, LCD1602 display bed number, alarm circuit alarm; When the doctor presses the reply key to reply, the LCD1602 clears one. If the reset button is not pressed, press another button, LCD1602 will display the corresponding hospital bed number in order, and the alarm circuit will give an alarm; MCU reset, the system reset. Studying this system can not only effectively improve the quality and effect of hospital service, increase the popularity of the hospital, improve the speed of information transmission between doctors and patients, but also provide timely treatment for patients. The system eliminates the drawbacks of cable system such as wiring trouble. It has the characteristics of fast installation, easy maintenance and long transmission distance. It can also be used in other industries after a series of optimization.

Keywords

MCU; Wireless call; Liquid crystal display; Alarm.

1. Introduction

With the rapid development of the medical system, many hospitals realize that they must pay attention to informatization construction, so as to further improve the hospital's service quality, medical level and various benefits. So it is very necessary to design a system that can make multiple wireless calls.

This article introduces the hardware selection process, working principle, hardware pins and functions of the wireless call system in the sickroom. According to the selected hardware component, combined with software to achieve the purpose of wireless calling. When there are no patients in need of service, the wireless transceiver module does not work, and the display shows no call. When a patient needs service, the patient presses the button, and the signal is processed and transmitted to the wireless transmitting module by the sending end single-chip microcomputer. This module transmits the signal to the wireless receiving module, which is then processed by the receiving end single-chip computer through the wireless receiving module, and finally displayed on the LCD The bed number and the alarm module will alarm, and the nurse can provide real-time service to the patient after receiving the information.

2. Overall Design

This system uses STC89C51 as the core control unit, uses eight buttons to simulate the call buttons of eight hospital beds, through the NRF24L01 wireless transceiver module, and finally displays the corresponding bed number on the LCD1602, and the alarm circuit gives an alarm. When a patient presses the button, the transmitter of the NFR24L01 wireless module sends a

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signal to the receiver. When the receiver receives the signal, the buzzer responds continuously and the LCD1602 displays the corresponding bed number. When multiple patients press the button, the display will display the bed number in sequence according to the call order. If the nurse receives a call, press the "answer key" to eliminate it, and the display will show the next caller. If a certain bed is called multiple times, this call will be invalid, and only the sequence of the first call will be displayed. The total system has a reset button. Press this button to restore the system to the state when no one is calling.

The specific design plan is shown in the figure below.

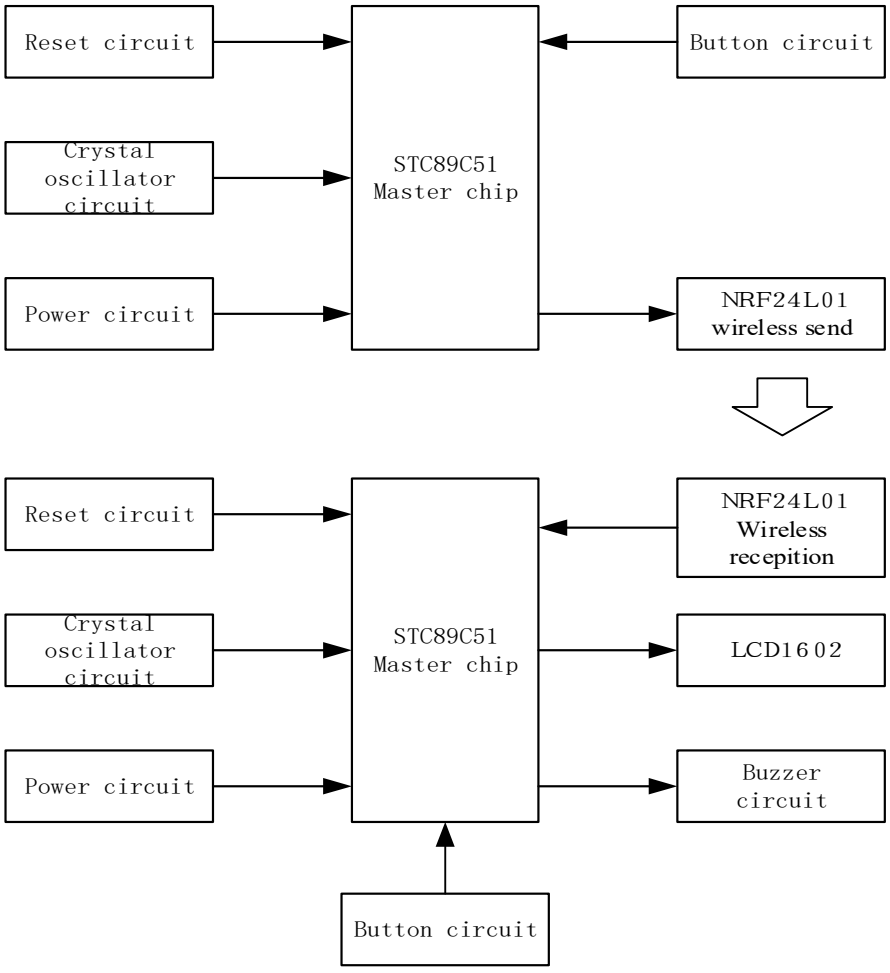

Figure 1. System plan

3. System Hardware Design

This chapter mainly introduces the basic parameters of the hardware, as well as some pin functions of the selected hardware. And we can understand the role of the selected module in this design.

3.1. Minimal System of STC89C51 Single Chip Microcomputer

STC89C51 is an 8-bit CMOS microcontroller with low power consumption and high performance. It has 8K in-system programmable Flash program memory, A/D digital-to-analog conversion module, and PWM modules. Although STC89C51 uses the classic 51 core, many improvements have been made so that the chip has functions not included in other 51 single-chip microcomputers. The 8-bit CPU and Flash of this chip have effectively expanded its field of use and provided a very flexible and effective solution for most embedded control application systems.

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The minimum system of the single-chip microcomputer means that the system that can make the MCU run with the fewest modules. In addition to the single-chip microcomputer, it also needs to include power supply, clock (crystal oscillator), reset and other modules.

(1) Power supply module

All electronic devices need power supply equipment, and STC89C51 is no exception. Since the voltage of this single-chip microcomputer is about 5V when it is working normally, the USB power cord is used here to connect the power supply for power supply.

(2) Clock module

It belongs to the internal oscillator circuit module of the chip (internal clock mode), and other timing components (a crystal oscillator and two stable frequency capacitors) are connected between the pins of XTAL1 and XTAL2 to form one with the internal module of the chip. A relatively stable internal oscillator, used to generate self-oscillation. Among them, the values of C1 and C2 are basically 30PF, and the frequency of the crystal oscillator generally ranges from 1.2MHz to 12MHz. If the oscillator material used is quartz, the selection range of the capacitor is 30PF±10PF. If the oscillator material used is ceramic, the choice of capacitor should be slightly larger, with a range of 40PF±10PF. Then, the capacitor of 30PF is used in this design.

(3) Reset module

The function of the reset circuit is to restart the single-chip microcomputer to restore the program to the initial state when the system runs away from the program or the power is unstable. Generally, there are two ways to reset the operation: power on and press the key.

In the power-on reset circuit, the charging of the capacitor is used to achieve the purpose of reset. When the power is turned on, the RST pin is at a high potential, and the capacitor is charged quickly. During the charging of the capacitor, the RST pin will drop to a low potential. The RST pin must be at a high potential for more than two cycles to reset.

In the button reset model, when the button is not pressed, the button circuit is not turned on, and the circuit at this time is like a power-on reset circuit. When the single-chip microcomputer is working, when the button is pressed, the capacitor rapidly discharges, and the potential of the RST pin rises to a high potential. Although the speed of artificially releasing the button is very fast, it still satisfies the single-chip reset. The following figure includes the above two reset circuits.

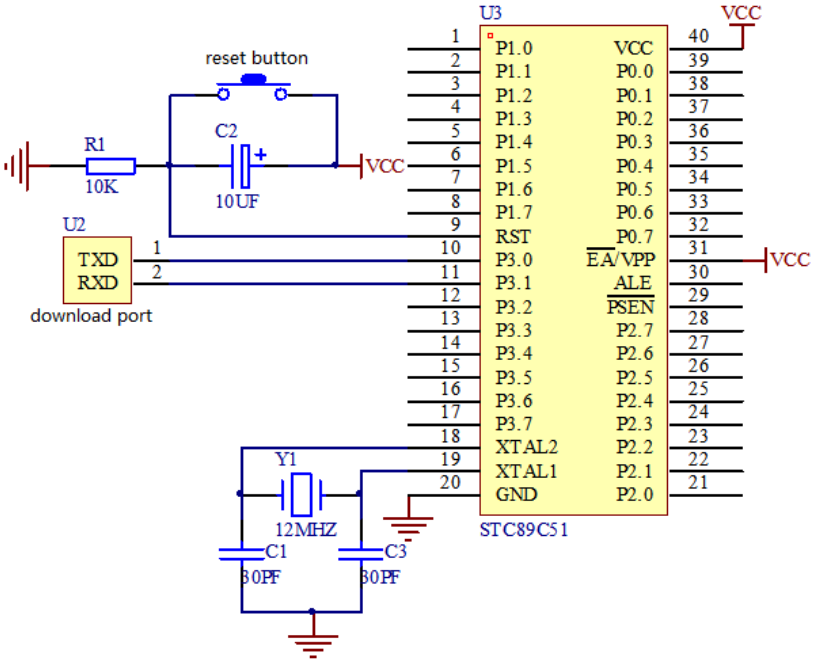

Figure 2. The smallest system of STC89C51

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3.2. LCD1602

The LCD1602 display is a dot matrix type, which can be used to display letters, symbols, numbers, etc., but cannot be used to display Chinese characters. The component can display 16×02, which is 32 characters, where 16 means that 16 columns can be displayed, and 2 means that 2 rows can be displayed. 1602 is composed of many 5*7 or 5*11 dot matrix character bits, and these character bits can be displayed and only one character can be displayed. Among them, there is a distance between the characters in each character position. Not only that, there is also a certain distance between each line. It is because of this discontinuous display that LCD1602 cannot display graphics better. Although some users can customize CGRAM, the result is obviously that the display effect is still not ideal.

LCD1602 is a 14-pin or 16-pin display component. The 14-pin has no backlight design, and the 16-pin has a backlight design, which can display more clearly.

In use, you can connect the pins 7~14 (eight-bit bidirectional data port) of LCD1602 to the P0 port of STC89C51 microcontroller, which can facilitate data transmission, and VL is connected to an adjustable slide line rheostat, because LCD1602 liquid crystal The contrast of the display varies with the resistance value of the sliding wire rheostat. Therefore, in practice, the use of potentiometers instead of fixed resistance resistors is to conveniently adjust the resistance so as to be suitable for different occasions.

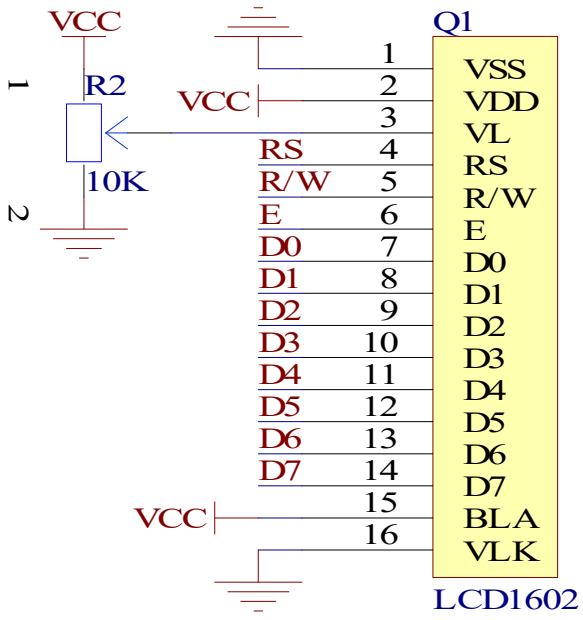

Figure 3. LCD1602 circuit diagram

3.3. Wireless Transceiver Module

NRF24L01 belongs to 2.4G wireless transceiver components and has its own proprietary protocol, which means that it can only be used for information transmission between itself and itself or between itself and the company's series of products. Generally, it is only used between two NRF24L01 Information transmissions, then they can be configured to send or receive data status. If it is information transfer between two NRF24L01, the following requirements must be met: first, the channels of the two NRF24L01 must be the same, then the addresses of the two NRF24L01 must also be the same, and finally the effective data width of the two transmissions or receptions must be the same. If any one of them is not satisfied, then even if the sender sends data, the receiver will not receive it.

When sending data, you must first initialize the wireless module, and then set the module to the sending mode, and then write the data to be sent and the address of the receiving port into

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the NRF24L01 through the SPI port. The address of the receiving port needs to be written once when the sending port is in the transmitting state, but valid data needs to be written continuously when the CSN is low, and then the CE port must be at a high level of at least 10 microseconds and 130 microseconds have passed After the delay, the module starts to transmit data. If this module turns on automatic response, it will start to change to receiving mode for data acquisition immediately after transmitting data.

When receiving data, you must first initialize the wireless module, and then set the module to receive mode, and then start receiving data after a delay of 130 microseconds. When the real and valid data is received at the receiving end, the data packet will be stored in the RX FIFO, at the same time RX_DR (interrupt flag) will change to high level, IRQ will change to low level, the interrupt will start, and then the MCU will start to acquire data. If this module turns on automatic response, the receiving module will enter the transmitting state to reply.

3.4. The Buzzer Circuit

The design uses 5V active electromagnetic buzzer. This module uses the current through the electromagnetic coil to generate a magnetic field around the coil to drive the vibrating membrane to produce sound, so as long as a certain amount of current passes through, it can sound. Because the working current of the buzzer is relatively large, and the output current of the single-chip microcomputer is slightly small, so that it cannot support the buzzer to produce sound, a current amplifying circuit must be added. What is used here is the 8550 type triode, which belongs to the PNP type triode, and a 1K resistor is connected in series with the base of the triode. When the output level of the I/O port of the single-chip microcomputer is low, the transistor is in the conducting state, the buzzer sounds, and the alarm circuit alarms; when the I/O output of the single-chip microcomputer is high, the transistor is cut off and the buzzer stops beeping , The alarm circuit cancels the alarm.

4. System Software Design

4.1. Software Introduction

This design uses Keil for programming. Keil 4 provides more databases and has powerful integrated development capabilities. Compared with assembly, C language has great advantages in many aspects, for example, it is slightly better in many aspects such as function, structure, and readability.

4.2. Main Functions of the System

A program that can make the system run normally, no matter how long the program is and how difficult it is to write, it is indispensable for the main function, (void main()). The main function main () is a starting point for all programs to start running. At the beginning of this function, the MCU and external devices used are generally initialized first. After the initialization operation is completed, an infinite loop will be entered. If the infinite loop is not entered, the program will only run once and then recover. If it enters an infinite loop, then the program will run endlessly in order to achieve the purpose of online monitoring.

In this design, the calling end is to detect the button execution information, and then transmit the button execution information to the receiving end in time, and the receiving end will perform the next step.

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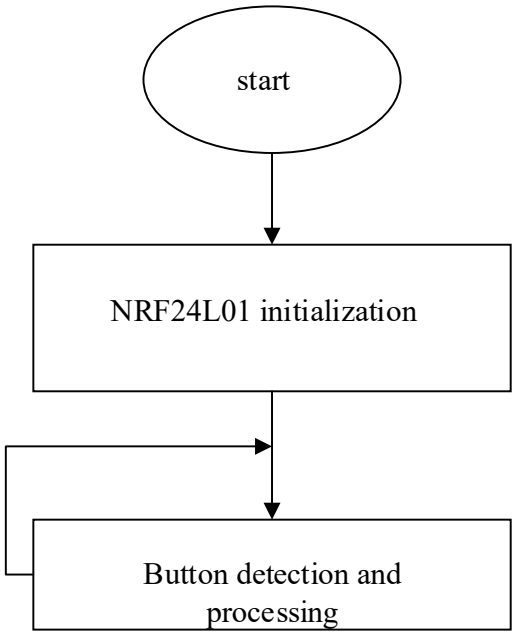

Figure 4. Flowchart of the calling end

On the receiving end, it is required to receive the information from the calling end in time, process the button information, and display the information in real time.

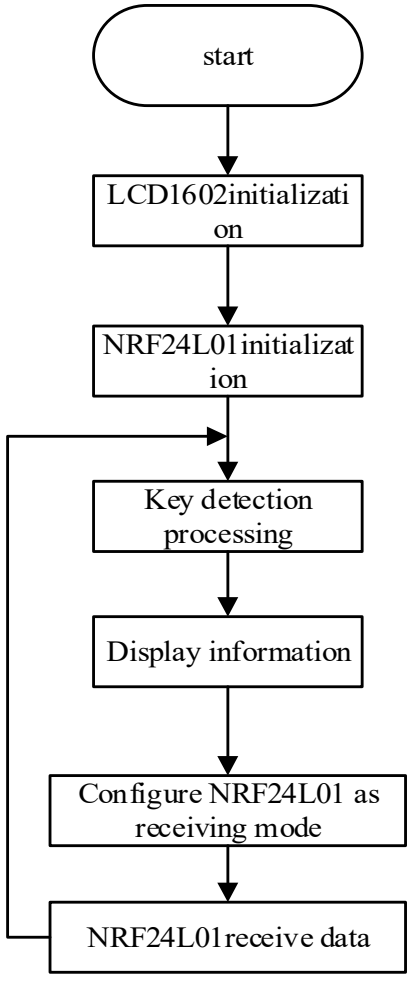

Figure 5. Flowchart of the receiving end

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5. System Testing and Analysis

5.1. System Simulation

Since this design uses the NRF24L01 wireless transmission module, there is no such module in the simulator. When I want to replace it with other wireless transmission modules, after some inquiry, it is found that there is no wireless transmission module in Proteus, so I decided to use wired Transmission instead of wireless transmission to make a simulation of a sickroom call system. The simulation is the same as the real situation that can be realized by wireless transmission. The following is the simulation result.

First, when there is no one calling, the power is turned on, the receiving end module display shows "No one to call", that is, no one is calling, and the buzzer in the alarm circuit does not respond.

Secondly, there are patient calls. In this case, there are several different calls, as described below:

1. Assuming that when there is only one patient calling (bed 1 call), 1602 displays the corresponding bed number of the calling patient, and the buzzer in the alarm circuit continues to respond;

2. Assuming that patients in multiple beds do not call repeatedly (bed 2 is called first, followed by beds 4 and 3), that is, each bed is called only once. At this time, the 1602 display will display the corresponding bed number in the order of calling;

3. assuming multiple hospital calls and repeated calls (sickroom 5 calls first, followed by hospital 6 calls, and hospital 5 calls again), the second call or multiple calls are considered invalid.

Finally, the doctor receives the call signal. If there is a sequential call for beds 2, 4, and 3, the display will display "243". When the doctor presses the answer button once, the display will display "43", clearing the first bed call; when the doctor presses the reset button of the MCU, the display content is the same as when there is no call.

5.2. Physical Test

The test of the wireless module is easily affected by factors such as distance and obstacles, and the influence is obvious. After several tests, the maximum transmission distance of the wireless module was measured. In the case of straight line barrier-free, we tested several call buttons, and the distance between sending and receiving signals is about 15 meters. In the state of the partition wall, the tested signal transmission distance is about 8 meters.

After physical testing, the test results are consistent with the circuit simulation results.

6. Conclusion

The design uses STC89C51 as the main control chip, and eight buttons are used as the call buttons of the eight hospital beds. After the NRF24L01 wireless transceiver module, the hospital bed number is finally displayed on the LCD1602, so to realize the design of wireless call system. This system not only simplifies the line problem on wired transmission, but also realizes the purpose of wireless calling. This not only improves the working efficiency of hospital staff, but also effectively reduces the disputes between doctors and patients, and increases the efficiency and quality of hospital services.

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