Research and Design of Wireless Communication Module Based on Single Chip Microcomputer

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Abstract: This paper studies a wireless communication control module with AT89S52 microcontroller as the control core. The basic principle, main circuit, hardware framework and software framework of the system are described in detail. The whole system adopts modular design, which mainly includes wireless communication control circuit between single-chip microcomputer and lower-level computer, and communication interface circuit between wireless communication module and 51 single-chip microcomputer. The communication control system communicates with the nRF2401 through the SPI of the 51 single chip microcomputer, thereby forming a connection with the lower computer through the wireless communication control module, controlling the lower machine motion controller, and saving the data received by the communication into the extended memory. The communication method of this module is simple, in addition to remote real-time control, it can also be widely used in industrial monitoring and data acquisition systems.

1. Introduction
With the maturity of short-range low-power wireless data transmission technology, wireless data transmission is increasingly applied to new fields. Compared with the wired communication method, wireless communication plays an important role in the field of modern communication because it does not need to lay out bright lines and is convenient to use. In the past, wireless products have limitations in scope and direction. As people have discovered, as long as two-way wireless communication-duplex communication is established and the wireless data transmission module is selected based on the micro-power single-chip RF transceiver nrf24l01 design, the data is completed using 89c52 microcontroller. With the processing and control of low-cost transceiver chips, many new applications will emerge.

2. Introduction of MCU
The STC89C52 has UART and SPI interfaces, while the nRF2401 uses DRI, CLK and DATA three-wire transmission. Considering the rate factor, the connection between the STC89C52 and nRF2401 is ready to be implemented using the SPI interface. The SPI (Serial PeriPheral Interface) interface is a synchronous serial peripheral interface that allows the MCU to communicate with various peripheral devices to exchange information. Peripherals include Flash RAM, network controllers, LCD display drivers, A/D converters and MUCs.
**Figure 1 Typical SPI master-slave bus structure**

1) **MOSI (Master Output Slave Input):**
   This 1-bit signal is directly connected to the master and slave. The signal is serially transmitted from the master device to the slave device via the MOSI line. Therefore, for the master device, MOSI is the signal output port, and for the slave device, it is the signal input port. On this line, a Byte signal passes through the high (MSB) to low (LSB) transmission.

2) **MISO (Master Input Slave Output)**
   Through this 1-bit signal line, the signal is transmitted from the slave device to the master device, so it is the signal input port of the master device and the signal output port of the slave device. The signal is also transmitted from MBS to LBS.

3) **SCK (SPI Serial Clock)**
   This signal is used to synchronize the MOSI and MISO data of all devices. It is driven by the master device for 8 clock cycles, allowing the exchange of 1 Byte on the serial line.

3. **Introduction of Wireless Module**
   The nRF24l01 wireless module is used in this system, the main features of the chip are as follows:
   1) The global open ISM band is 2.4G, free of license.
   2) The maximum working speed is 2Mbps, and the GFSK modulation of colleges and universities has strong anti-interference ability.
   3) 125 optional channels to meet the needs of multi-point communication and FM communication.
   4) Built-in crc error detection and point-to-multipoint communication address control.
   5) Low operating voltage (1.9–3.6v).
   6) Auto answer can be set to ensure reliable data transmission.
   The chip communicates with an external MCU via SPI, and the maximum SPI speed can reach 10Mhz. The module we use in this chapter is the NRF24L01 produced by Shenzhen Yunjia Technology. The maturity and stability of this module are quite good.

1602 character LCD module that displays numbers and letters. Compared with the digital tube, the display content is richer and the programming is simple. It displays the current working time of the system, the time, and the temperature detected by the temperature sensor. It is convenient for user observation. The interface signals of LCD1602 are described in Table 1.

| Numbering | Pin symbol | Function Description                  | Numbering-g | Pin symbol | Function Description |
|-----------|-----------|---------------------------------------|-------------|-----------|----------------------|
| 1         | VSS       | Power ground                          | 9           | D2        | DATA I/O             |
| 2         | VDD       | Positive power supply                 | 10          | D3        | DATA I/O             |
| 3         | VL        | Liquid crystal display bias signal     | 11          | D4        | DATA I/O             |
| 4         | RS        | Data/command selection (h/l)           | 12          | D5        | DATA I/O             |
| 5         | R/W       | Read/write selection (h/l)            | 13          | D6        | DATA I/O             |
| 6         | E         | Enable signal                         | 14          | D7        | DATA I/O             |
4. Wireless Communication System Design

4.1. Hardware circuit board design

In this system, the board is designed using Protel 99SE software. The main steps of the board design are: schematic design → generation of network tables → printed circuit boards. The schematic diagram of the hardware circuit board is shown in Figure 2:

![Figure 2 Schematic diagram of the hardware circuit board](image)

In hardware design, you need to pay attention to the following points:
1. The power cord should be thickened, properly routed and grounded;
2. Avoid 90 degree fold line when wiring, try to make a smooth transition;
3. Fully consider the load-carrying drive capability of the single-chip microcomputer.
4. Select a typical circuit as much as possible, and conform to the conventional use method of the single chip microcomputer;
5. Under the premise of fully satisfying the system function requirements, leave room for secondary development;
6. The hardware structure design should be considered together with the software design plan;
7. The package size should be strictly in accordance with the actual size of the components, pay special attention to the space occupied by the components vertically;
8. The hardware must have reliability and anti-interference design, and the power supply should use capacitor filtering to enhance the stability of the power supply.

4.2. Software programming

The program design adopts the modular design method, and the program is decomposed and designed according to the principle that “any complex program can be decomposed into sequential structure parts, branch structure parts, loop structure parts and sub-program parts”. Structured programming has the characteristics of clear structure, easy to read and write, easy to verify and high reliability. It is widely used in programming and easy to manage files.

The modular programming idea is to use a top-down, step-by-step refinement method to decompose a complex problem into several independent sub-problems, each sub-question corresponding to a function-independent program module, which organically connects these modules together. To form a complete program. First, the design of the main program module is carried out, the overall framework of the program is described, and the sub-module design is performed to complete the corresponding sub-functions. In this system, it is necessary to separately design the programs of the transmitting end and the receiving end.

At the transmitting end, first enter the transmission working mode ce=1, load the receiving end
address and valid data through the i/o interface, and then start transmitting ce=0, and the transmitting end waits for the data transmission to be completed. When the transmission is completed, the module enters the receiving state and receives the response data of the receiving end. At the receiving end, enable reception. If the sender data is received, the received data is sent to the extended external ram, and the response data is sent to the sender.

5. Conclusion
The research in this paper is mainly to use a wireless transceiver circuit, plus a single-chip control and liquid crystal display to make a complete point-to-point data transceiver system. Taking into account some of the current market demands, the main requirements for the design are low cost, small size, low power consumption, high integration, no need to adjust external components, short transmission time and simple interface. The system has the advantages of reliable performance, strong anti-interference ability, low power consumption and high cost performance, and has important application value and good development prospect in the field of wireless communication.

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