Simple Wireless Transceiver System Design

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Abstract:In recent years, wireless remote control technology in modern industrial and agricultural production, scientific research, national defense and other fields have range of applications.With the development of modern science and technology, the requirement of remote control technology is more and more sophisticated, designers need to overall consideration, optimization design of the remote control system. Because the radio waves are transmitted by launch in all directions, can cross the barrier, and can spread to far distance, so it can control in large area and space, become the main way of remote control, remote control of home appliances technology is applied very much.We design remote control eight leds is one of the small application, is mainly designed by FSK modulation, made into high frequency signal to send signals to the receiver, then by receiver demodulation rebuilt the useful signal, to control circuit, by controlling the driving power to complete control lamp, including the signal transmitting and receiving is the key, and the remote control code decoding of the circuit design, and gives some system anti-interference and energy saving measures.

1. Introduction

The demand for portable devices is one of the factors driving the rapid development of wireless transceiver technology solutions. In daily life, people have become accustomed to home appliances controlled by wireless schemes such as infrared, although these wireless schemes have limitations in scope and direction. In car alarms, security systems or advanced hi-fi with many options and menus, if cheap wireless technology is deployed and a small display is added to the remote control, the device can show the user its status change. Therefore, only by expanding the range of wireless communication and establishing two-way wireless communication-duplex communication can many new applications appear[1,2]. Applications include automatic meter reading, wireless computer peripherals, automotive, wireless data communications, alarm and security systems, wireless keyboards, wireless joysticks, home automation, telemetry, and toys.

In the fields of telemetry and remote control, people usually use a microcomputer and a single-chip computer to form a multi-machine communication system to complete the measurement and control tasks. Therefore, people think of wireless transmission. Frequently used wireless transmission methods include wireless short-wave transmission and infrared transmission, but these two transmissions have certain limitations[9,11]. For example, short-wave transmission is

susceptible to interference from external electromagnetic fields, and external transmission cannot be transmitted through walls.

As wireless transmission is used in more and more fields, its technology is also increasingly demanding[2]. In recent years, with the development of radio technology, short-range, low-power wireless transmission technology has become more and more mature. Wireless transmission is mainly used in communication. At present, our common communication methods include wired communication and wireless communication. The difference between wired communication and wireless communication lies in the different transmission media. Wired communication uses tangible media such as metal wires and optical fibers. Wireless communication is A communication method that uses electromagnetic wave signals to exchange information. Compared with the wired communication method, wireless communication has the advantages of no need to set up open wires and convenient use, etc., and occupies an important position in the modern communication field. The wireless transceiver system is mainly used in radio remote control in daily life. The radio remote control sends signals through radio waves. It has the advantages of low power consumption, triggering work, standby and hibernation. Radio remote control of the device is more convenient and flexible, making it more widely used in daily life.

This article designs a remote control and a control object. First, input the bit number of the required control circuit through the key coding circuit (effective low level in this experiment). We use the coding circuit to generate information with address coding and response switch state information. Encode the pulse signal, and then transmit the signal through the radio transmitting circuit. The radio receiving circuit confirms the address of the received encoded pulse signal through the decoding circuit, and then decodes it. By controlling the small light bulb and LED light, the wireless signal transmission and reception functions are realized.

2. Related Work

The wireless transceiver system is a remote control device that uses radio signals to control various devices in the distance. The generated radio signal is processed by the transmitting end and sent, and after receiving by the receiving end device, the mechanical equipment is driven to complete the corresponding operation. The radio remote control system is a supplement to the infrared remote control in the presence of obstacles and long-distance transmission[4,6,11]. It has been widely used in electric doors, gateway remote control, anti-theft alarm devices, industrial controls, and wireless smart homes.

In the early nineteenth century, people began to study how to transfer information using electrical signals that could be passed along lines. Telegraph was invented in 1837, and Maxwell established the electromagnetic field theory in 1873. Bell invented the telephone in 1876, which directly converted sound signals into electrical signals and propagated along wires. At the end of the nineteenth century, research into the transmission of radio signals could send messages in the form of electromagnetic waves in space. In 1895, Marconi of Italy and Popov of Russia invented the radio, realized radio communication, and created the practical value of radio waves. With the advent of various electronic components, radio, fax and television appeared[5]. Until the mid-1930s, radio technology was mainly developed in the above-mentioned communications. Until today, radio technology has continued to improve and develop.

3. Wireless Transceiver System

Utilizing the transmission characteristics of radio waves, a radio-based remote control transmitting and receiving system is designed. At higher operating frequencies (6 to 10 MHz), the modulation of

the object is achieved through amplitude keying (ASK modulation), and the receiving is required. The distance from the transmitter to the transmitter is not less than 10m.

In the entire system, we design two parts, namely the transmitting system and the receiving system[8]. The working principle of the system is to first input the bit number of the required control circuit through the key addressing circuit, and at the same time start the coding circuit to generate a coded pulse signal with address coding information and switch status information, and then transmit the signal through the radio transmitting circuit. The radio receiving circuit confirms the coded address of the received coded pulse signal through the decoding circuit, confirms whether it is the remote control switch system address, and then drives 8 remote control objects through the drive circuit, and one of them is a small light bulb with a brightness of 7 Level adjustable. Three-digit binary code is used to indicate various control states, as shown in table 1.

Table 1: Object Control Status.

Number	A	B	C	function
1	0	0	1	Light 1 work
2	0	1	0	Light 2 work
3	0	1	1	Light 3 work
4	1	0	0	Light 4 work
5	1	0	1	Light 5 work
6	1	1	0	Light 6 work
7	1	1	1	Light 7work

3.1. Transmitting Circuit

The transmitting module is composed of a key coding circuit, a coding circuit, and a radio transmitting circuit[7]. For the transmission of all signals, there must be a signal source, just like simple communication between people, and our voice is the source of the signal. In this wireless transceiver system, the transmitted radio is generated by a change in the circuit in the conductor, and the radio wave is generated by a change in the strength of the current in the conductor. The generated signal is controlled by a button and is subjected to FSK modulation to move the signal to a suitable transmission spectrum, and then sends it out after power amplification. The signal transmission process is shown in Figure 1.

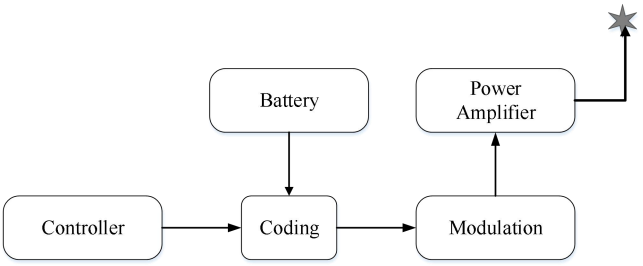


Figure 1: Launch module.

3.2. Receiving Circuit

The signal sent by the transmitting end is transmitted to the receiving end through the antenna. The signal will be lost during the transmission process, so the power amplification is performed at the receiving end, and then the modulated signal is demodulated into the original signal. The receiving system will receive the encoded pulses. The signal confirms the address through the decoding circuit, and then drives the controlled object through the decoding output.The signal receiving process is shown in Figure 2.

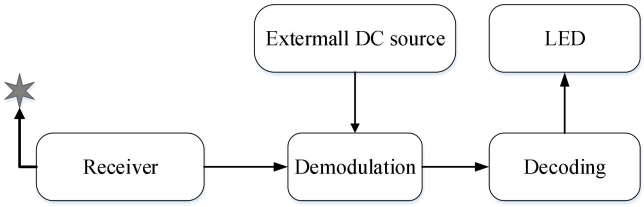


Figure 2: Receiver module.

Reception and transmission are a reverse process. First, the receiving device is composed of a preamplifier and a power amplifier. The heaviest task of the receiving device is to extract useful information from the radio waves carried by long-range radio transmitters. The resulting electrical signal is converted into a digital signal and then entered into a "demodulator".

3.3. Modulation and Demodulation

The modulation circuit and demodulation circuit are very important components in the communication circuit. The message signal output from the signal source generally has a wide frequency spectrum starting from zero frequency, and a large amount of energy is distributed at the low end of the frequency spectrum, so it is called Baseband signals are not suitable for direct transmission in the channel. In order to facilitate transmission, improve anti-interference ability and effectively use bandwidth, it is usually necessary to move the spectrum of the signal to a suitable frequency range of the channel and noise characteristics for transmission by modulation. So at the transmitting end, we transform the modulated signal from low frequency to high frequency to facilitate signal transmission[9]. At the receiving end of the system, the modulated signal is demodulated to restore the original message.

The object to be controlled according to our experimental purpose is 8 lights, 7 of which are small light bulbs that are lit alternately. We use LEDs instead. The LEDs emit light to indicate work, and the controlled state uses binary coding. We use amplitude keying (ASK modulation) to control. Because digital signals have rich low-frequency components and are not suitable for wireless transmission, we need to perform high-frequency sinusoidal modulation on the baseband signal, which also improves the ability to resist interference.

3.4. Coding and Decoding

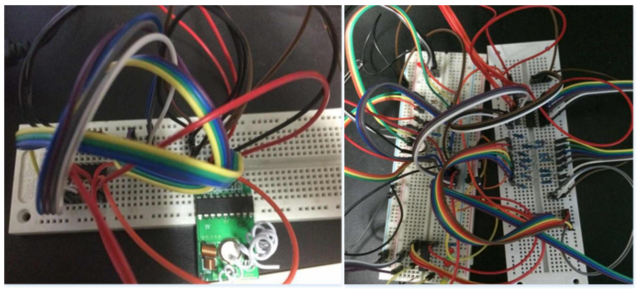
PT2262 / PT2272 is a pair of encoding / decoding chips designed for radio remote control circuits. At the transmitting end, PT2262 receives the encoded three-bit parallel data, and then serializes it after encoding. In order to improve the reliability of signal transmission, PT2262 sends data twice in each encoding cycle. The receiving end PT2272 first performs address confirmation on the received serial data. When it is the same as the local address code, it decodes the received data and outputs the data code in parallel. With PT2262 and PT2272, the re-encoding and decoding of control signals can be satisfied.

PT2262 and PT2272 are used to encode and decode the control signals to facilitate the transmission of symbols in the wireless channel. PT2262 generates a unipolar code whose duty cycle changes with pass 0 and pass 1. A set of codes includes a 5-bit address code and a 4-bit data code. In this design, PT2262 has nine-bit input terminals, of which five bits are address codes and are set, that is, low level. The other four digits are the data input. If the address code of PT2262 is changed, you can use one PT2262 to control multiple PT2272s. In this experiment, we only control one PT2262.

4. Design and Manufacture of Circuits

4.1. Breadboard

For the transmitting module, we use eight keys for the high and low levels of the encoding chip. We have reached the control of the signal to the transmitting module for transmission by radio waves. The receiving module uses the receiving chip sc2272 corresponding to the PT2262 to receive the electrical signal from the transmitting end, and then realizes the control of the small light bulb through the decoding chip. In the first step, we initially implemented our own circuit design on the breadboard, and the breadboard also facilitated us to correct circuit design errors.Breadboard circuit implementation shown in Figure 3.



Launch Receiver

Figure 3: The result on breadvoard.

4.2. PCB Board

After successfully implementing all the functions we want to achieve on the breadboard, the nRF401 wireless transceiver circuit was designed and manufactured using Protel DXP software. In Protel DXP software, make the connection circuit according to the design circuit, package the circuit, make the PCB board, set the layout range, load the netlist and component library, automatically place and do the adjustment circuit, the automatic wiring process, and finally adjust the entire circuit board. It implements 3D functions. Generate reports and netlists, set up devices that have existing simulation models in the circuit, and run the circuit simulation process in Protel DXP software, then print the circuit board 1: 1, and finally weld the formed PCB circuit components to achieve Application circuit. The transmitting and receiving circuit PCB is shown in Figure 4.

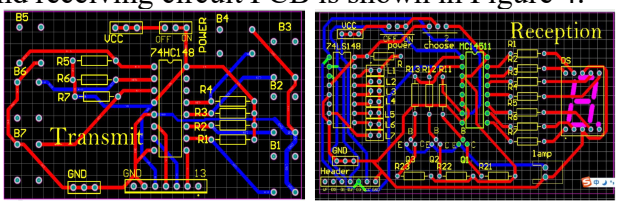


Figure 4: The design of PCB.

The left side of the Fig4 is launch and the right side is receiver.The design of the printed circuit board (PCB) is directly related to the RF performance. In order to obtain better RF performance, the PCB design requires at least two layers of boards to implement. The PCB is divided into two parts: the RF circuit and the control circuit. The actual circuit uses a PCB antenna with no ground plane under the antenna. The power of the RF section is separated from the power of the digital circuit section. In order to reduce the influence of distribution parameters, long power supply traces should be avoided on the PCB. All component ground lines, VDD connection lines must be as close as possible to the components, and the power supply must be well filtered.

5. Conclusions

After getting our printed circuit board, we started soldering, corresponding to the circuit we originally designed, soldering the corresponding components and small chips. The circuit board is shown in Figure 5.

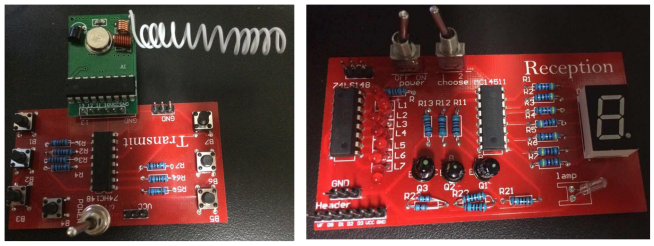


Figure 5: Circuit board.

There are two function modules that need to be controlled in the receiving system. One is the switch for general control, and the other is the function selection through the single-pole double-throw switch. The system realizes two functions in total, as shown in the figure 6: 7 small bulbs alternately flashing some of the achievements, this function is to send control signals through 8 buttons on the input end, and wirelessly control the small bulbs on the receiving end.

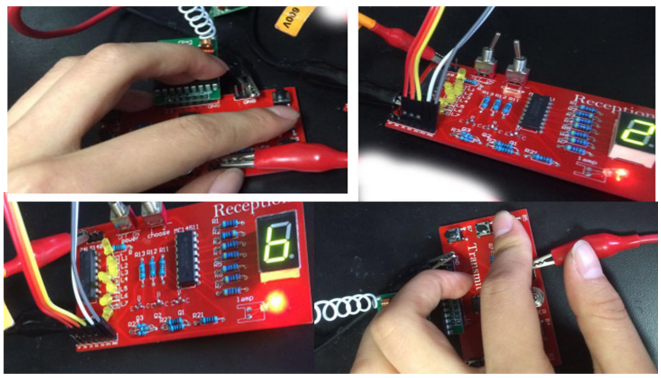


Figure 6: Different brightness of light.

Switch to another function module, you can adjust the brightness of the small bulb, and display the brightness level through the digital tube. Some of the results are shown in the figure 7.

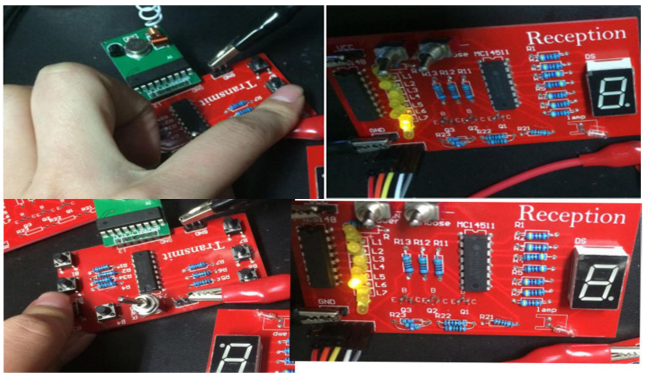


Figure 7: Alternating lights.

Wireless transceivers are widely used in smart homes, wireless telecommunications, industrial automation and other fields due to their stable and reliable applications, long wireless transmission distances and strong anti-interference performance[10]. At present, wireless transceiver systems have become a development trend. This paper uses the buttons to flexibly control the LED lights to realize the design of the wireless transceiver system. During the design of the radio remote control module, PT2262/PT2272, a pair of infrared remote control transmitting/ receiving chips with address and data encoding functions, is used to make the circuit design of the transmitting and receiving modules More simple.

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