

Design of Multi-Protocol RFID Reader with Chinese LCD Monitor

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Abstract

A design of a multi-protocol RFID reader with Chinese monitor is proposed in the paper. The reader is consisted with 4 modules which functions as follows: A STC12 series microcontroller is used as the processor, a LCD module which type is NOKIA5110 as the monitor to display the information and results of the process, a USB module as the power and the module based on CD4052 is used to extend the serial port controlled by the microcontroller to realize the selection of different protocols RFID modules.

Keywords

Multi-protocol; RFID; Chinese LCD Monitor.

1. Introduction

Radio Frequency Identification (RFID) is a wireless communication technology that is used to identify specific targets, read or write the information through the radio signal^[1]. And there is no contact between the recognition system and a specific target either mechanical or optical.

The RFID technology is applied to many scopes, such as: tracking on production lines, individual identification in animal husbandry, Electronic Purse for transport cards, etc.

2. Introduction

The application system based on RFID is composed of three parts: reader, transponder and antenna^[2]. The radio waves of a specific frequency is transmitted from the reader to the transponder, and then the transponder drives the circuit to send the specified information as the answer through the antenna after getting the radio. The Reader receives and processes the relevant data according to the specified protocol at last.

The information will be exchange bidirectionally between reader and transponder in the typical system. In the complex application system, the identified target data needs to be uploaded to the application software or server platform for processing. Therefore, the circuit or module for communication is usually need or designed in the reader. Complete the data exchange between the reader and the platform, to complete related functions such as switch control.

The purpose of this design is reading of multi-protocol RFID tags. However, because RFID has multiple frequency bands which means that there are different frequency bands, different protocols and different difficulties, then it's difficult to realize this function through one circuit board. In order to achieve the design objective, multiple communication ports are designed for realizing the reading of different protocol tags.

In addition, using NOKIA5110 as a monitor to display the information can not only prompt the operation process and results intuitively, but also facilitate used offline.

Based on the above objectives, the design takes the microcomputer as the core, and the scheme includes: power supply, MCU control unit, sound and light prompt unit and peripheral interface unit.

3. System design

3.1. Hardware Design

The device based on the MCU microprocessor consists of a few parts as follow: the USB interface is used to supply power to the system, and receives or sends the command and data from the application software through serial communication with the computer. According to different instructions, it drives the switching of the analog switch to communicate with different radio frequency modules. And then completes to communicate with the tag of different protocols, and displays the operation results, which can be sent to the corresponding application software at the same time.

1. Power supply and MCU control unit

In this design, the microprocessor which type is STC12C5206AD^[3] is used as the core chip, and the frequency of the crystal oscillator is 11.0592Mhz. At present, the interfaces of most radio frequency modules are SPI and UART. For this purpose, two groups of data communication interfaces are designed to realize the SPI and UART interfaces communication respectively.

In terms of power supply, this device adopts a standard USB interface, and a self-locking switch is designed. As the power-on control device of the power supply, it has the characteristics of low cost, convenient, “plug-and-play” and stable power supply.

2. Sound and light prompt unit

The reader is designed with a prompt circuit including 3 LEDs and a buzzer which are used as power indicators respectively. By controlling the relevant I/O ports, LEDs of different colors are turned on or off, accompanied by beeps of different rhythms, and then different states are prompted , such as: successful or failure to read the tag, detection failed , etc.

3. Peripheral interface unit

Communication is the main function of this unit which respectively completes the data exchange between the reader and the system and the communication between the MCU and each RFID module.

In terms of data communication, the most simple and practical serial communication is adopted. A serial port expansion circuit based on the chip CD4052^[4] is designed, and the multi-protocol RFID tag data is recognized by using multiple serial ports in time-sharing read.

In addition, the SPI interface is reserved on the mainboard of the reader, which is used to connect the RF read head of the SPI interface.

In terms of display, NOKIA5110 is used as the screen to display the relevant information with Chinese.

3.2. Software programming

The main functions of the design are as follows:

- (1) Communicate with the different RFID module with different communication interfaces and different protocol.
- (2) Expand the Serial port.
- (3) Prompt the different sound and light.
- (4) Prompts the information about the operation processing and results with Chinese.
- (5) Communicate with PC.

In order to realize the above requirements, the main flow of program is design as follow steps:

System initialization;

Display the current state;

Select the designated port according to the settings or commands;

Send related commands;

Receive and process data;
Display the operation results on the LCD;
Send the results to the upper machine software.

4. Conclusion

Compared with the products currently sold in the market, the design of this reader has considered practicality and convenience, which has the following characteristics:

1. Simple operation and intuitive effect

Sound and light prompts and LCD display design are controlled by the I/O port of MCU. and it also has a Chinese display function, which has an intuitive effect and is beneficial to users.

2. Easy to debug and measure

Products on the market are usually highly integrated and almost completely sealed due to cost and other reasons, and it is difficult to monitor and measure data in intermediate links. In this design, the debugging interface and multiple test points are reserved on the circuit board, which is conducive to the monitoring of intermediate link data by electronic enthusiasts, thereby deepening the understanding of professional theoretical knowledge.

3. Modular design with low cost, multi-protocol support

Usually, the RFID products that support multi-protocol sold in the market are more expensive. But in the design based on the concept of modular, comprising one motherboard and multiple interfaces to achieve the support of different protocols by modifying the program of the motherboard, so that the hardware cost is much lower than similar products.

4. Multiple interfaces for further expansion

Except the communication interface with the PC, 2 UART interfaces and an SPI interface are designed. Different interfaces have different driving difficulties. Not only can be it used as a sample for electronic enthusiasts to debug, but also it can be used for practical teaching in colleges and universities to meet deeper teaching needs, such as: curriculum design, use of practical training, etc.

References

- [1] Fulihua, Jinmingtao, Yangyue, et al. RFID Technology and Product Design, Publishing House of Electronics Industry, 2017, p:2
- [2] Huangyousen. Radio Frequency Identification (RFID) Technology and Application, Publishing House of Electronics Industry, 2011:4
- [3] STC12C5206AD Datasheet [EB/OL]. <http://stcmcu.cn.china.cn>
- [4] CD4052B Datasheet [EB/OL]. http://www.ic5.cn/p_CD4052B_am4m.html