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# Design and Implementation of Network - based RF Card Read and Write System

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## Abstract

Radio frequency identification (RFID), also known as electronic tags (e-Tag), is an RF signal automatic target recognition and access to relevant information technology. The paper detailed introduces the basic principle of radio frequency card read and write system based on network, analyzes the key technology of cable network and wireless network, and puts forward the design scheme of radio frequency card literacy system. This paper first analyzes the basic principle of radio frequency card literacy system, the research direction and application situation. In fully studied the basic principle, technical characteristics of radio frequency card, and then puts forward the radio frequency card reader system design method based on STC12C5A60S2 microcontroller. Design the cable terminals, wireless terminals, the repeater, and client software.

## Keywords

Radio Frequency Identification(RFID); IC Card; STC12C5A60S2.

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## 1. Introduction

Now China has begun to have a large number of non-contact IC card in public transport in many cities, time and attendance system, the second generation ID card, campus card, etc[1,2]. At this stage of the domestic use of the reader's core RF circuit read and write chips are basically using Philips, TI, ATMEL and other foreign companies dedicated ASIC chip. These RF chip peripheral circuit is simple, easy to design, but because of such chips more expensive, thus limiting some of the more stringent requirements on the cost of occasions.

Based on STC's STC12C5A60S2 microcontroller and the company's TEMIC series of RF card read and write base station chip U2270B, we design a practical IC card reader. The non-contact IC card reader system hardware consists of single-chip, non-contact IC card read and write parts, receive and send coil, power, reset and buzzer circuit and the host computer (PC) communication interface. We write to complete the non-contact IC card by a program, and a communication port communicating through asynchronous serial communication interface with the PC. The design regards practical use as a starting point, quickly, simple, convenient, reliable and stable non-contact IC card data read and write operations as the purpose, and further expand the field of non-contact IC card applications.

## 2. Principles of Radio Frequency Identification System

PHILIPS company's Mifare S50 (M1) card, mainly contains RF antenna and ASIC components, as shown in Figure 1. ASIC is mainly composed of high speed RF interface, data read and write control unit, storage tool EEPROM[3,4]. When the card reader reads and writes to the radio frequency card, the card reader continuously sends out a set of electromagnetic waves with fixed frequency. The

frequency of electromagnetic wave is the same as the resonance frequency of the built-in LC resonant module of the M1 card, which causes the resonance of the LC resonant module to generate the charge in the capacitance of the resonant circuit. The capacitor is transferred to another capacitor by a special transmission. When the accumulated charge voltage reaches 2 V, it can be used as a power supply to the various circuit devices in the card, so that the reader can read and write the RF card.

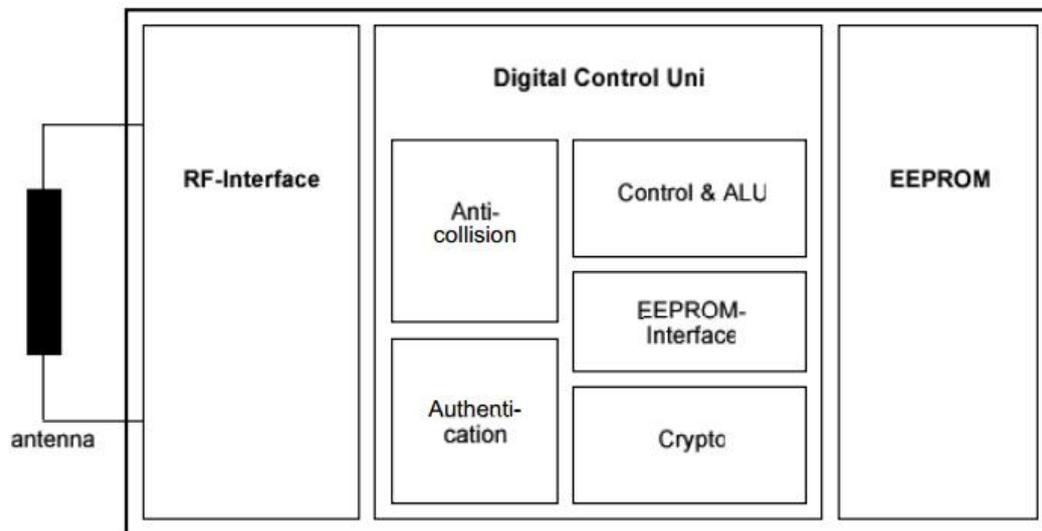


Figure 1. Non contact IC card reading and writing structure

The main function of high speed RF interface is to receive the power supply voltage generated by the LC resonant circuit and the reset signal and the clock signal[5]. The main function of the data reading and writing control unit is to modulate and decrypt the data transmitted by the radio frequency interface, and to carry out the interactive processing of the data according to the specific steps and the card reader. After the initialization of the serial connection between the card reader and the computer,

Sector	Block	Byte Number within a Block														Description		
		0	1	2	3	4	5	6	7	8	9	10	11	12	13		14	15
15	3	Key A				Access Bits				Key B						Sector Trailer 15		
	2																	Da
	1																	Da
	0																	Da
14	3	Key A				Access Bits				Key B						Sector Trailer 14		
	2																	Da
	1																	Da
	0																	Da
:	:																	
1	3	Key A				Access Bits				Key B						Sector Trailer 1		
	2																	Da
	1																	Da
	0																	Da
0	3	Key A				Access Bits				Key B						Sector Trailer 0		
	2																	Da
	1																	Da
	0																	Manufacturer Blo

Figure 2. IC card EEPROM structure

it starts to look for the RF card in the working frequency range of the reader. If at the same time, a plurality of radio frequency cards are sensed, the card reader can start an anti-collision mechanism control module to select one of the cards. After selecting the card to be processed, the reader determines the area code to access, and checks the sector password. After the 3 mutual authentication, we can carry on the communication through the encrypted stream, and read and write to the card reader. After the success of the operation start alarm control module, prompt operation success, at the same time to hang the card. EEPROM is a radio frequency card storage unit that is used to store the information written by the reader. M1 RF card storage space is 8 KB. Storage space is divided into 16 sectors, each sector is divided into 4 blocks, each block of memory size of 16 B. The 64 blocks are

named by physical order, and the serial number is from 0 to 63. The zeroth block is the serial number of the radio frequency card, which can be written directly by the manufacturer and can not be changed. In addition, each sector of the fourth block is the sector of the password storage block, which includes two sets of passwords and password read control byte. The remaining 3 is a block of data, you can store data and the corresponding data manipulation, as shown in figure 2.

### 3. General design principle

This design is mainly composed of wireless card terminal, cable card terminal, transponder and PC end software, as shown in figure 3.

(1). The wireless card reader reads the IC card data, displays the user name at the terminal, and transmits the data to the transponder through the NRF wireless communication module. The transponder receives the data and forwards it to the PC software.

(2). The cable reader reads the IC card data, displays the user amount at the terminal, and can be used for the terminal consumption. Consumer data can be sent to the transponder via the RS485 bus, which receives the data and forwards it to the PC software. This feature simulates the restaurant consumption function.

(3). The function of the transponder is to receive the data of the wireless attendance terminal and the cable card terminal, and forward the data to the PC terminal software.

(4). The PC client software processing and forwarding data, determine the type of data, in the terminal display attendance table and consumer records And the data stored in the database for the user at any time

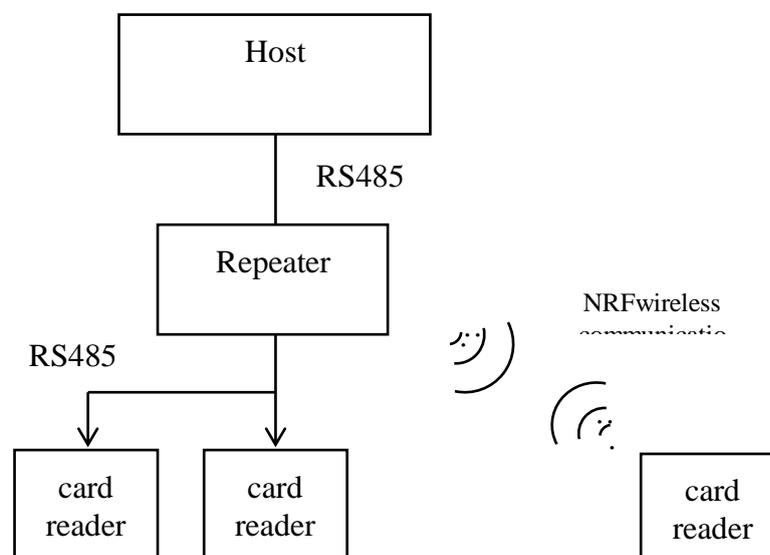


Figure 3. RF card read and write system diagram

#### 3.1 Wired read-write terminal

Read and write terminal, through the IC card read and write module, read the IC card number and amount, and display on the LCD screen. Through the button, enter the amount deducted, stored in IC card, display and sent to the transponder, as shown in figure 4.

The wired read and write terminal uses RS485 bus to communicate with the transponder module to simulate the function of the restaurant card reader.

The system first initialize the program, and then check whether there is a card. If there is a card, then read the card number and card balance, and LCD display. Then the system waits for the key to enter the amount of the deduction, and then press the confirmation key after the input. If there is no button

pressed for a period of time, then wait for the jump, re check whether there is a card. After deduction, the system will send the data in a certain format to the transponder.

### 3.2 Wireless read-write terminal

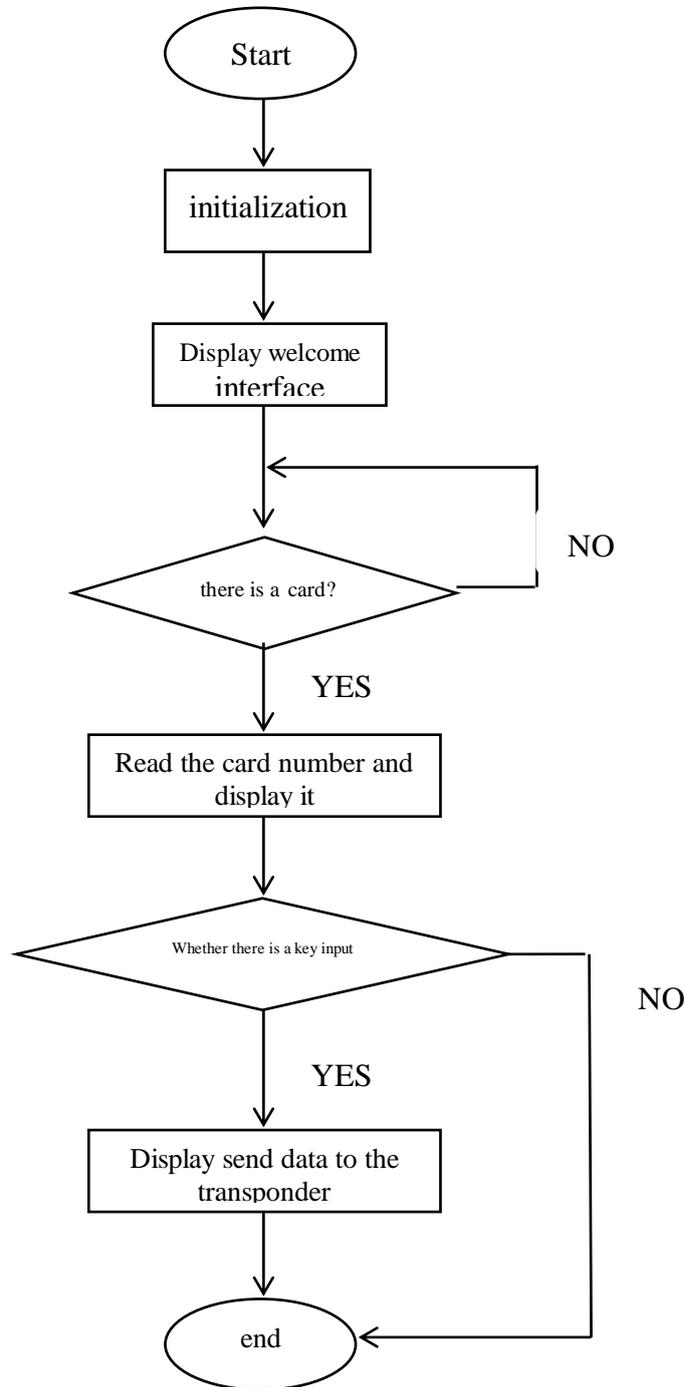


Figure 4. Cable reader terminal system flow chart

Wireless read and write terminal, through the IC card read and write module to read the IC card number, and display the user name on the LCD screen. The data sent to the transponder through NRF24L01 wireless transceiver module, and then sent to the PC terminal software transponder.

The system first initialize and display welcome screen Then check whether there is a card, no card is returned to continue to detect, when there is a card, then read the card number, and the system to match

the card number, display user name. Then the data is encapsulated into a certain format, and the data is sent to the transponder with NRF wireless.

The data is stored in the first sector of the IC card EEROM. The system uses a custom data protocol. A total of 8 bytes of data, where the starting byte bit 0x55, one byte byte has a stop bit 0XAA, wireless, 0X11 cable, 0x22 wireless, a byte address bit sequence number one byte, three bytes of data. The specific format is as follows table1.

Table1. Data Format

Start bit	Wired Wireless	Address bit	serial number	Data 1	Data 2	Data 3	Stop bit
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The sequence number of IC card accounted for 5 bytes, including 4 byte serial number, check a byte. However, in order to save storage space, the system only selected one of the bytes, but also to distinguish between different cards.

#### 4. Conclusion

In a word, in this paper, we achieves the expected purpose, and the system is simple, low cost, strong practicability, can be easily embedded into other systems (such as access control, public transportation, restaurants), become a part of the user system. Unfortunately, due to the rush of time, computer software design is relatively simple, the next step is to create a better interactive, more powerful user software.

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