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Design of Password Lock Based on Fingerprint Recognition

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Abstract: *In recent years, with the rapid development of science and technology, fingerprint identification has been applied to many fields and achieved good results. Fingerprint identification has high security. The progress of all kinds of science and technology has gradually reduced its production cost. This also promotes the rapid development of fingerprint identification.Therefore, in this design, a fingerprint identification electronic password lock system is designed with a single chip microcomputer as the core. The single chip microcomputer is used for fingerprint identification and password identification, and the LCD screen is used to display the corresponding interface and data. The sampling relay module simulates unlocking, LED lights and buzzers. Perform button prompts and alarm processing. The overall volume of the system designed in this design is small and has a high cost performance. This design is based on 51 single chip microcomputer as the basis to design a fingerprint identification electronic code lock, combined with the design requirements, the STC89C54RD+ single chip microcomputer is selected, and the fingerprint module is ZFM-40, which has rich functions and can access fingerprints. It communicates with the fingerprint module ZFM-40 through the UART function of STC89C54RD+, and the specific exchanged content is realized in the form of code. The liquid crystal equipment selected is HS12864-15C, which has a high degree of integration and is suitable for ordinary family use. Through the 3-wire serial data interface and the microcontroller for data transmission, the corresponding interface and data are displayed on the HS12864-15C, such as: main menu, administrator interface, unlocking and error information, etc., which is convenient for users to view and use. In the design, the relay is used to simulate the lock, and the high and low level output of one pin of the single-chip microcomputer controls the closing of the relay public end and the normally open and normally closed ports, so as to control the power on and off of the strong electric device to achieve the purpose of unlocking. The test results meet expectations, the functions envisaged in the early stage are basically realized, and the design has the characteristics of low cost.*

Keywords: *Single-Chip microprocessor, Fingerprint detection, LCD, Biometrics*

1. Introduction

1.1. Background and Significance of Fingerprint Recognition Technology

With the progress of science and technology, personal private information is increasing, authentication password is used in many fields. For example, the startup password and bank password. Each type of code comes with a different key. For example, car keys, safe keys, etc. The security of traditional locks is poor and can not meet the needs of modern development. In recent years, with the rapid development of science and technology, people have put forward higher requirements for password security, requiring more simple and fast security authentication. In order to solve these problems, scientists have devoted themselves to the field of biometrics. By extracting human biometrics to realize identity recognition, individuals will be able to change the dilemma of carrying a large number of keys when traveling, and individuals will not have to memorize various passwords. Biological features are permanent, unique and unreplicable. Scholars have proposed that the global population is about 6 billion, in the next 300 years will not appear two identical fingerprints, so fingerprints can be used in the electronic banking security authentication process, can effectively prevent others from counterfeiting problems. In addition, with the rapid development of the Internet, information grows exponentially. At present, there are many problems in the security authentication of bank ATM and POS terminals, so it can be combined with biometric characteristics to achieve effective identification of personal identity.

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At present, biometric technology mainly includes: face recognition, fingerprint recognition and so on.

Fingerprint recognition technology is becoming more and more mature, so its application field is also expanding, and effectively change people's lives, improve the security of personal identification[1].

1.2. Principle of Fingerprint Recognition

Individual finger surface skin has breakpoints and intersections. Fingerprint image is similar to binary image, so fingerprint can be used as a sign of personal identification. Early prints were taken by pressing, but this type of fingerprint collection produced poor images. Since then, with the progress of science and technology, people have begun to use scanners to collect fingerprints. However, due to the influence of various factors such as illumination, the gray value of the images is poor, so fingerprint matching cannot be realized later.

1.2.1. The General Working Mode of Fingerprint Recognition

Fingerprint is a typical biological feature with unique characteristics. Fingerprints have been studied earlier. As early as the 1970s, automated fingerprint recognition systems have been proposed. After decades of development, fingerprint recognition technology has been relatively mature, the technology has been integrated into various fields, effectively changing people's lives.

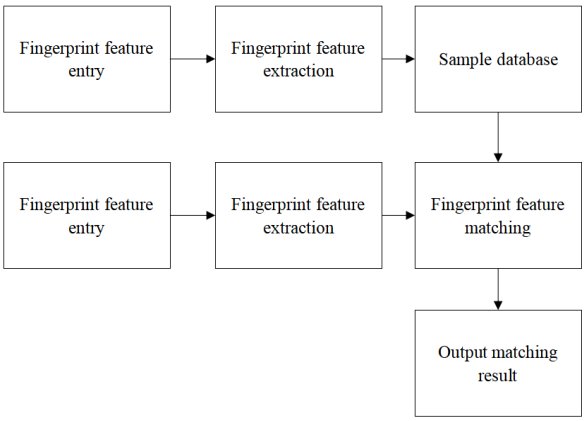

Figure 1: General fingerprint recognition system.

Figure 1 shows the fingerprint recognition system.

The process of fingerprint recognition is as follows: collect the fingerprint, grab the features of the fingerprint, compare the two pairs of fingerprints, and the detailed steps include the following steps:

Firstly, the collection of fingerprints can be realized. Since human fingerprints have texture and unique features, sensors can be used to collect fingerprints and convert them directly into digital images. Secondly, the fingerprint features are extracted to obtain the global features of the fingerprint image, and the local features are analyzed to lay a foundation for the subsequent fingerprint identification. Thirdly, the effective matching of fingerprint features is realized, and the correlation algorithm is used to compare the features of two fingerprints.

1.3. The Main Content of This Paper

With the rapid progress of society, the identification in the early years has been unable to meet the requirements of the development of modern society. These identification methods include passwords, etc., but the above identification methods are easy to be forged and embezzled, so they cannot meet the needs of modern development. Fingerprint is a relatively mature biological identification method, and has strong stability. Individual fingerprints were created as early as six months of age, and their characteristics did not change after death and decay. In addition, fingerprints are unique. Scholars have shown that no two people will have identical fingerprints for another 300 years, and twins will have very different fingerprints. Fingerprint recognition technology has applicability, maturity and security, and it will become the mainstream recognition technology in the future. Automatic fingerprint

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identification technology has created a new era, changing people's lives, making people's lives more convenient and safe.

This design takes STC89C54RD+ as the core, designed a fingerprint password lock, the system includes fingerprint acquisition module, unlock module, display module and so on. As for the fingerprint collection module, its function includes the collection of fingerprint information. As far as the unlocking module is concerned, the data will be processed and the fingerprint information will be matched. Determine whether to open the lock. The function of the keyboard control module is to enter the password, enter the administrator mode, confirm, return, adjust the time and reset the function. The function of display module is to display initialization menu, administrator interface, unlocking status and other interactive interfaces with users. For users, it can be unlocked by fingerprint or password, and the unlocking time will be recorded.

2. Design of Password Lock Based on Fingerprint Recognition

2.1. The Conceptual Design of the Design

The design based on fingerprint recognition of the design of the password lock consists of four modules, are responsible for fingerprint acquisition module; Responsible for processing the collected fingerprint, input password and control of unlocking data processing and unlocking module; Responsible for password input, enter the administrator mode, return and confirm and adjust the display time keyboard control module; Figure 2 shows the display module that displays initialization information, administrator interface, and lock unlocking information. All modules coordinate to complete the data acquisition and processing of electronic fingerprint combination lock.

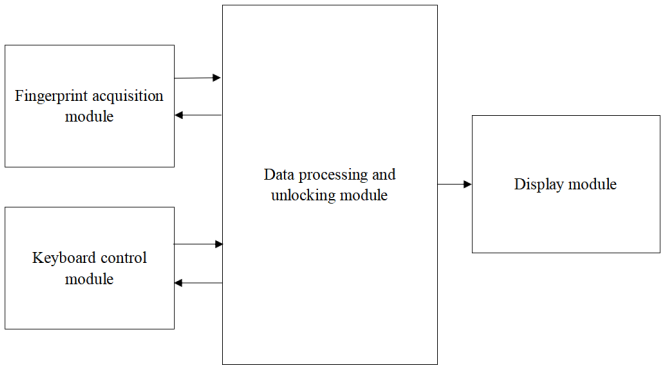

Figure 2: Overall system architecture.

2.2. System Workflow

When turning on the system, press the power button. After pressing the power button, the indicator will light up and the screen will display "Please enter your fingerprint". If the fingerprint is successfully matched, the LED light of the system will light up, and the person who successfully unlocked the lock can enter the system. At this time, the screen will display "Successful fingerprint matching". If the match fails, the LED light will not be lit, and the lock cannot be correctly unlocked.

To enter the administrator mode, perform the following operations: Press the operation key to enter the password and match the password. If the password is correct, the administrator mode is entered. If the password is successfully entered, the administrator mode is entered. After entering the mode, the administrator can perform the following operations: Input a new fingerprint, delete an existing fingerprint, and change a personal password. To record a new fingerprint, the administrator can perform the following operations: Place the finger on the collector, lift the finger and put it back to the collector repeatedly until the fingerprint is successfully taken. If the administrator wants to delete the fingerprint, view the recorded fingerprint and select Delete. The administrator can also modify the personal password, click Modify, enter a new password and save, the password will be stored in the database.

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2.3. Summary of This Chapter

In this paper, the module is designed, and the working process is introduced, the model of each device is selected, the hardware circuit is analyzed, and the control chip is selected according to the established scheme. After selecting the control chip, the hardware circuits of fingerprint acquisition module, data processing and unlocking module, keyboard control module and display module are designed according to the requirements. Combined with each specific module, the working principle of each module is analyzed, and the cost-effective components suitable for the design requirements are selected[2-4].

3. Hardware Introduction and Design

3.1. Single Chip Microcomputer and Minimum System

3.1.1. STC89C54RD+ MCU Introduction

Most of the MCU internal integration of CPU, RAM, ROM, etc. It can also support interrupt and timing. Some of the enhanced microcontrollers are equipped with AD converter, PMW and LCD LCD display. The functions of different series of microcontrollers are quite different and can be applied to different scenarios.

STC89C54RD+ microcontroller is a domestic product, its low power consumption, can effectively resist external interference, fully compatible with the traditional 51 microcontroller instructions, and it is compared with STC89C52RC, in memory capacity expansion, but its function and STC89C52RC no difference.

Figure 3 shows the detailed pin information.

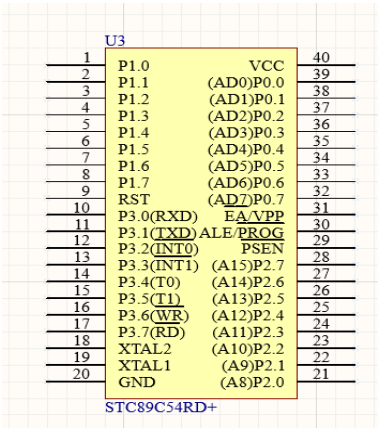

Figure 3: STC89C54RD+ pin diagram.

3.1.2. Design of External Crystal Oscillator

In the conventional application process must be added crystal oscillator, which is a key part of the single chip microcomputer, its role is to produce the frequency required by the clock, if the frequency of the crystal oscillator is higher, the corresponding single chip microcomputer has the faster running speed. The MCU must take the clock frequency as a reference signal when executing various instructions.

The crystal oscillator inside STC89C54RD+ MCU is 11.0592MHz. The microcontroller is equipped with an oscillating circuit inside, so it needs to be connected with an external crystal oscillator and a capacitor whose capacity is greater than 15pF and less than 50pF. Figure 4 shows the external crystal oscillator circuit.

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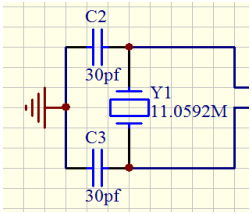

Figure 4: External crystal oscillator circuit.

3.1.3. Design of Reset Circuit

The core of the reset circuit of the single chip microcomputer in the actual operation process is the RST pin to obtain the high level of two machine cycles, and the cycle must be maintained for at least two machine cycles to trigger the normal start of the reset. By increasing the application of RC circuit, the function of constant calculation can be realized.

When the MCU is powered on for a short time, the PC circuit can be charged, and the RST pin will generate a positive pulse signal. This pin has a high level for two cycles. It should also be noted that the size of the resistance is 10K, while the size of the capacitor is 10uF.

Figure 5 shows the reset circuit.

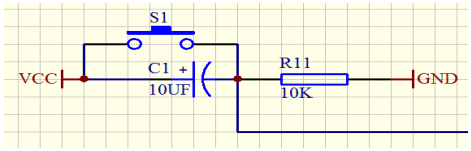

Figure 5: Resetting the circuit.

3.2. Liquid Crystal Display Module

3.2.1. Controller Interface Description

Basic operation timing sequence: In terms of reading state, specific input instructions include RS=L, RW=H, E=H, while in terms of output, D0-D7 will output status word. In addition, in the aspect of writing instructions, the corresponding input information includes D0-D7 part as instruction code, and E end as high pulse signal, in addition, RS end and RW end will input L, and the output can be carried out through D0 to D7 ports.

Status word description: The controller should carry out read and write detection in each operation link, to ensure that the port of STA7 is 0, in essence, because the actual operation speed of the MCU is slower than the speed of the liquid crystal part, so there is no need to carry out read and write detection for this aspect, only need to meet the corresponding requirements after a short delay processing. For details, see Table 1:

Table 1: Description of status words.

STA7 D7	STA6 D6	STA5 D5	STA4 D4	STA3 D3	STA2 D2	STA1 D1	STA0 D0
STA0~6		The value of the current data address pointer					
STA7		Read and write operations were enabled			1: Forbid 0: Allow		

3.2.2. Instruction Specification

LCD12864 instructions have clear display, address return, initial mode setting, display state, cursor or display shift control, function setting, set CGRAM address, set DDRAM address, read busy state and address, write data to RAM, read RAM value, standby mode, anti-white selection, sleep mode, etc.

3.2.3. 12864 Pin and MCU Connection Diagram

Figure 6 shows the connection effects of the ports.

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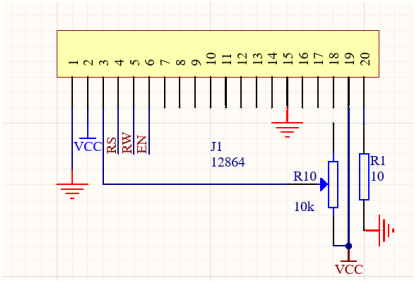

Figure 6: Connecting pins of 12864 to the MCU.

The core role of the display module is to display data. If you want to realize the display function, you must carry out the initialization operation. Before receiving the display command, the MCU first needs to detect whether the module is in a busy state, and then the corresponding content will be displayed on the display screen.

3.3. Key Control Circuit

There are usually two kinds of methods in the interface design of keys, which are mainly independent and matrix keyboard. In this design, due to the large number of keys and the full consideration of the simplicity of keyboard design and system stability, the matrix keyboard scanned by the line reversal method is finally adopted to carry out the design. The detailed key circuit is shown in Figure 7. When the keys are pressed down, the corresponding level will be low, so it needs to be processed by software.

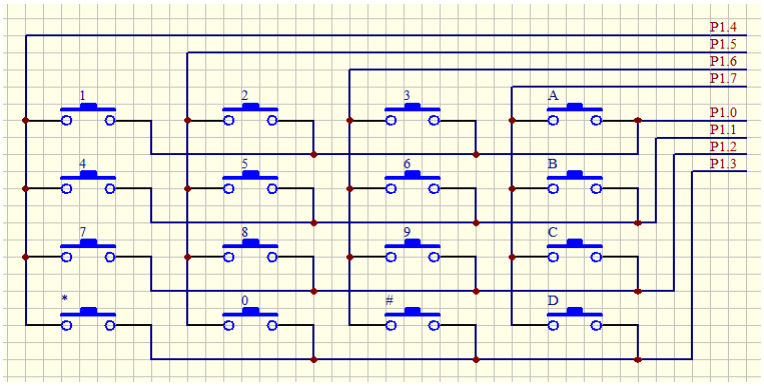

Figure 7: Key circuit.

3.4. Fingerprint Module

3.4.1. Introduction to Fingerprint Module

In the aspect of fingerprint module, ZFM40 is the main device used in the design of this paper, and its detailed circuit principle is shown in Figure 8.

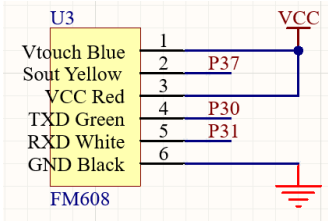

Figure 8: Ports on the fingerprint module.

As for the fingerprint module, its core component is DSP chip, the specific model of which is AS608. After being combined with the external CMOS chip, fingerprint photography can be carried out and fingerprint characteristics can be obtained at the same time. The following figure shows one kind of fingerprint template. A template is generated by entering the features twice.

The process mainly includes: complete the input of fingerprint image, obtain the relevant features of

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finger prints, and finally obtain the composite template. Figure 9 shows a fingerprint template.

Figure 9: Fingerprint template.

The collection of fingerprint information is mainly realized by increasing the use of modules and internal CMOS chips, and then they will further analyze and process it, and the fingerprint information will be transformed into relevant information composed of 0 and 1 digits, and then stored in the internal storage space.

The specific model of fingerprint module is ZFM40. The whole module mainly includes: CMOS sensor, FLASH chip, DSP, voltage regulator chip, communication line, optics and other related parts.

3.4.2. Fingerprint Module Command

For this part of fingerprint module, in the process of operation, the command is mainly sent and received by the single chip microcomputer serial port. First of all, you need to use the serial port to send relevant commands to this module, and then wait for the module for data transmission, and then use the single chip microcomputer again to process all kinds of data, and then can effectively determine whether the command can be executed, specific commands include the following:

To make the module shake hands at startup, the process also needs to judge whether the module works normally. The corresponding related commands are summarized as follows:

Authentication password: Table 2 shows the format of the instruction package:

Table 2: Instruction package formats.

2bytes	4bytes	1 byte	2 bytes	1 byte	4bytes	2bytes
Packet Header	Module Address	Packet Identification	Packet Length	Instruction Code	Password	Checksum
0xEF01	Xxxx	01H	07H	13H	Password	SUM

Table 3 lists the format of the reply packet.

Table 3: Formats of the reply packet.

2bytes	4bytes	1 byte	2 bytes	1 byte	2bytes
Packet header	Module address	Packet identification	Packet length	Confirmation code	Checksum
0xEF01	Xxxx	07H	03H	xxH	SUM

Note: If the confirmation code is 00H, it indicates that the password verification is correct. If it is 01H, it indicates that there is a problem with packet receiving. If it is 13H, it indicates that there is a problem with the password.

After the above related processing, fingerprints can be input, repeat the above steps, and finally other fingerprints can be input into the database.

In terms of fingerprint recognition, it is necessary to convert it into recognition mode first. After comprehensive scanning, it can determine whether the current fingerprint appears in the collection head. If it does, it will conduct in-depth scanning of the fingerprint, and comprehensively compare the data of the fingerprint database, so as to further read the fingerprint.

3.5. Clock Chip DS1302

For the DS1302 chip, its composition includes oscillator, control logic circuit, register and other parts. In the process of data transmission of single chip microcomputer, it only needs to rely on RST, I/O, SCLK, which can be realized. The specific principle of the whole work is as follows: First of all, RST pins are required to drive, and then SCLK will send a clock pulse. Under the action of this pulse, byte information such as related commands or addresses can be further transmitted to the MCU with the help of I/O pins. Subsequently, with full cooperation with SCLK pulses, data reads and writes can

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be carried out with the help of I/O ports. This also makes it easier to realize in the single chip data transmission process. Figure 10 shows the pin arrangement and internal structure of DS1302:

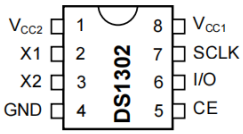

Figure 10: Pins of the DS1302.

3.6. Summary of This Chapter

This chapter mainly introduces the main control software STC89C54RD+ microcontroller in the system, and focuses on the analysis of each pin. In addition, it also discusses the principle of the minimum system. In addition to the specific use of the display screen and the key points of programming to carry out a corresponding description, in addition to the key programming analysis, explain the corresponding purpose of adding anti-shaking program in the key scheme, finally also a comprehensive introduction to the fingerprint module, the design of the key program modules are listed one by one[5-6].

4. The Design of System Software

4.1. Main Program Flow Chart

Based on the analysis results, the program flow as shown in the following figure can be obtained. The whole main program flow is shown in Figure 11.

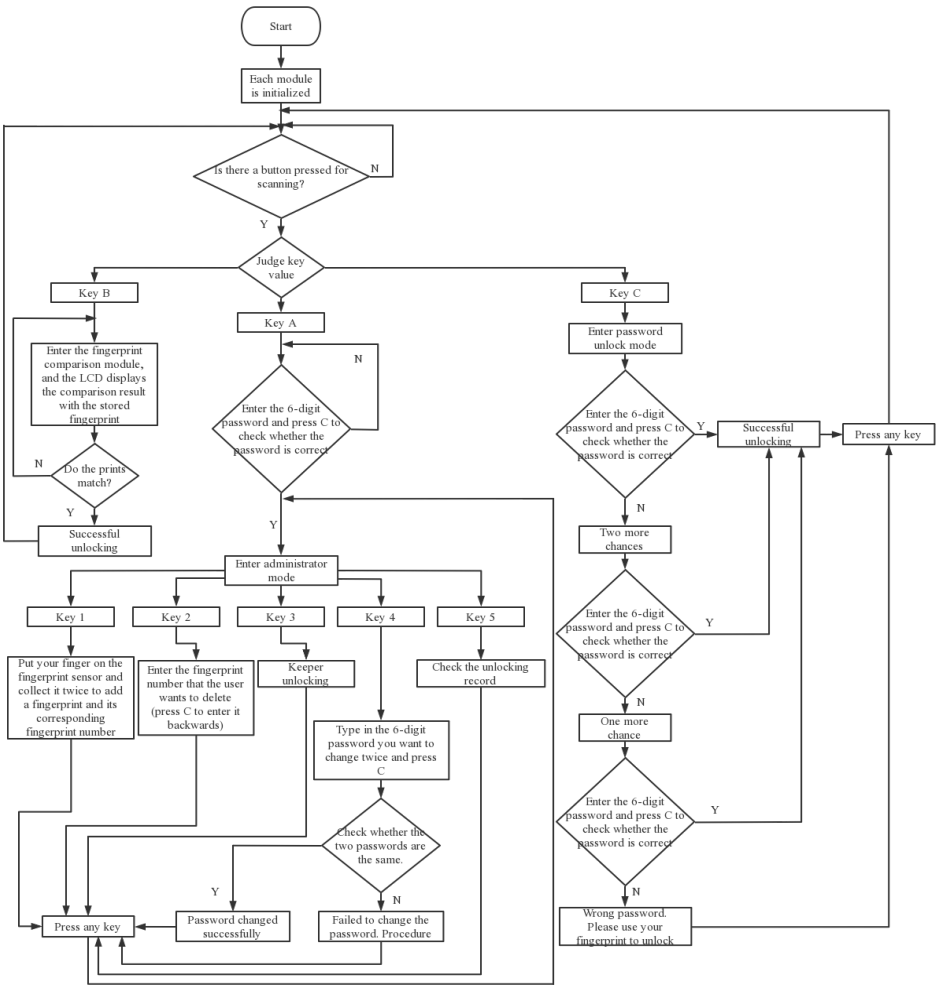

Figure 11: Main program flow chart.

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Firstly, the initialization operation should be carried out for each hardware module in the system to analyze whether there is a key action, in addition, it should be clear which specific key is.

The composition of the program mainly includes the liquid crystal display, keys and other related parts. The detailed process of the main program in the running process is: first of all, it is necessary to fully scan each module of the hardware part, respectively carry out the initialization operation of each part, and then call each module part again.

4.1.1. Keyboard Management Program Design Process

Figure 12 shows the working flowchart of the keyboard module.

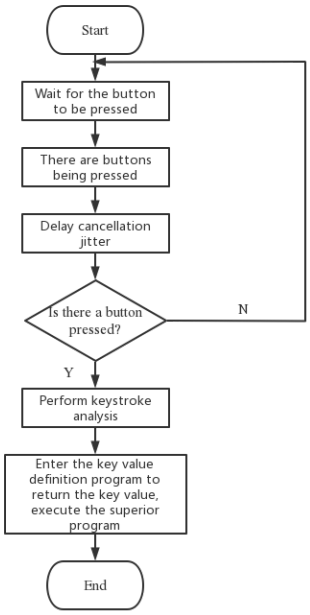

Figure 12: Flowchart of the keyboard program.

First, scan the keyboard to see if any keys are pressed. If yes, it will be detected again after the delay is eliminated. If it is detected again that there is a key pressed down, it will carry out key value analysis and enter the corresponding subroutine to perform the corresponding function.

4.1.2. LCD Display Module Program Design Flow

The display module mainly completes the display function of data, and then displays the content on the display screen based on the relevant instructions received.

Figure 13 shows the detailed operation flow of a display module.

Start by initializing LCD12864, clearing the screen, and clearing DDRAM; Then the initial interface, the main menu, is displayed; After that, write the corresponding commands and data to the LCD12864 in order to complete the corresponding function.

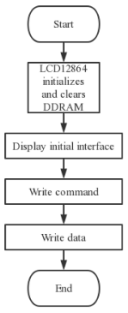

Figure 13: Shows the flowchart of the program.

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4.1.3. Fingerprint Module Communication Program Design Flow

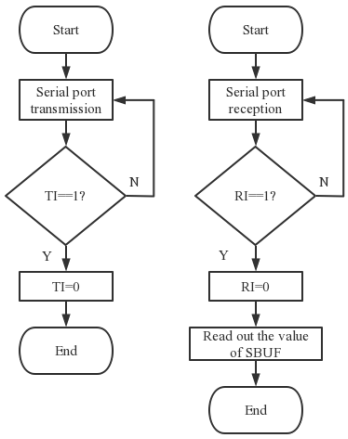

Figure 14: Flowchart for sending and receiving serial port communication data on the fingerprint module.

Figure 14 shows the flowchart for sending and receiving serial port communication data of the fingerprint module.

When the microcontroller sends data to the fingerprint module, it should read the TI flag bit to check whether the transmission is successful. If TI=1, the transmission is successful, and finally the TI flag bit is cleared. When the microcontroller receives the data sent by the fingerprint module, it reads the RI flag bit to check whether the data is received successfully. If RI=1, the data is received successfully. After reading the value in the SBUF, the RI flag bit is cleared.

4.2. Keil Programming

Before this formal design has completed the hardware part of the full connection, in the whole circuit of the main air is the single chip microcomputer, under the action of the single chip microcomputer can be further mobilized keys, liquid crystal, fingerprint module and many other parts. However, if you want to achieve specific functions, you need to use the application program. This time, the main language is C, and the tool is Keil when editing the program.

The corresponding process of using this software is as follows:

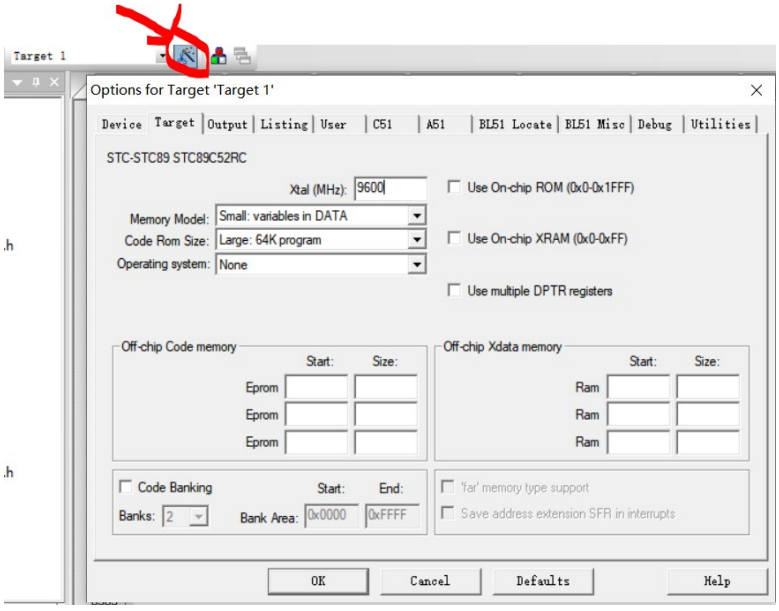

Figure 15: Setting the baud rate.

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First of all to create a new project and from the options to choose the single chip microcomputer model selected in this paper; Next, create and name a new text file with the name main, and then add it to the nearest data group. Finally, click the icon shown by the arrow in Figure 15, and enter 9600 in the pop-up dialog box. At this time, the operating frequency of the single chip microcomputer can be set to 9600 MHZ.

After that, the label operation should be further carried out, the specific category should be selected, the hex file format should be output, the source program should be modified through C language, the program should be debug-tested continuously, and the formal application should be carried out after repeated testing.

4.3. Summary of This Chapter

This chapter mainly selects the corresponding hardware part, and makes a comprehensive analysis of the process of software design. At this time, it also introduces the core code in the system module, and explains how to use Keil software to edit the program. The Fingerprint.hex file was created, and in the later burn session, if you want to further indicate that the system is working in order, you need to keep it consistent on the clock state[7].

5. Hardware Debugging

5.1. Circuit Welding

Preparation before welding: before welding, we should be fully familiar with the circuit board assembly drawing, but also according to the specific requirements of the drawings for the required application of all parts of the material, the device model, quantity, specifications and other aspects of the check, analyze whether to meet the requirements of the drawings, the lead part before welding molding preparation.

Welding sequence: In the process of welding components, the corresponding welding sequence refers to: First, the resistance is welded, then the capacitor is processed, then the diode, audion and other parts are processed again, and finally the integrated circuit and high-power tube and other related parts are welded again, and in other related components not mentioned in the order of small first and then large.

5.2. The Writing of the Program

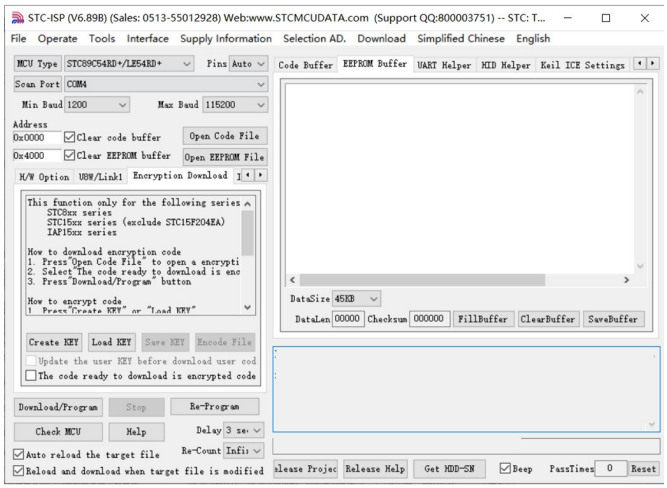

Figure 16: STC-ISP interface.

The software used in the process of programming is STC-ISP, which is widely used in various models of single chip microcomputer. Figure 16 shows the page.

With the help of STC_ISP_V688 this software will successfully debug the code burned to the single chip microcomputer, this software in the specific use process of the steps are as follows:

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First of all, open the software, select the corresponding model of the microcontroller, and then carry out port selection. When downloading, determine that the format is hex format. At last, just click the download button to start the program writing.

After the successful power-on, the main program of the single chip shall carry out the initialization of each part of the program, and then carry out relevant detection on the key part. If the key is not pressed down, other similar operations shall be performed. The single chip shall also read and write the relevant data in the fingerprint module by means of the serial port.

5.3. Debugging of Small Lamp and Relay

First of all, press the power button to fully observe whether the current indicator light is on. If the microcontroller is found to be on at this time, then you can confirm that the circuit function is normal. Later, it is necessary to analyze whether the single chip microcomputer can operate normally. After editing the program, it is written into the single chip microcomputer. It is necessary to analyze whether the relevant small lights indicate normally under the premise of normal operation of the program, and verify that the single chip microcomputer can operate normally.

5.4. Liquid Crystal Debugging

Import the designed program into the LCD screen. After successful power-up, it is necessary to adjust the contrast of the display with the help of potentiometer. In the process of adjustment, some small squares are noticed, which are mainly caused by failure in the initialization process. The core reason is that the program does not receive the initialization instruction correctly. It can be improved by standard debugging processing or adding a certain time extension to the initialization instruction. The final result obtained after debugging is shown in Figure 17.

Figure 17: LCD.

5.5. Debugging Fingerprint Module and Buttons

Import the designed program into it to analyze whether the fingerprint module and related keys can operate normally. The detailed steps in the operation process are as follows:

First, after the power button is triggered, the power indicator can be lit at this time; Second, after pressing the asterisk button, the screen can give relevant prompts for fingerprint entry again; Third, the finger can correctly touch the action of the relay when placed in the fingerprint recognition module, and the LED light will be constant, which can also control the opening of the door. You can return the interface to its original state by pressing any button. If the identification process does not correctly identify the fingerprint, it can not trigger the door opening action, the LED light will not change, can not open the lock operation, to prompt the user to re-input the fingerprint; Fourth, after button A is pressed, a 6-digit password needs to be input, and then the corresponding password data can be deleted through button B. On the premise of ensuring the accuracy of the data, press D button again. If the input password is correct, then you can successfully enter the administrator interface; Fifth, if the administrator mode can be successfully entered, press the 1 button at this time, its function is to re-enter the fingerprint. Follow-up to complete the fingerprint collection, press twice during the input

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process to collect the fingerprint data, so that the fingerprint data can be correctly stored. After successfully saved, the interface can be returned to the administrator interface by any button; Sixth, the fingerprint information can be deleted after pressing the number button 2, and corresponding prompts will be given on the interface after the successful deletion. The button to confirm the deletion is button D. If the fingerprint number is wrong, the "B" button can be used to delete. Seventh, if there is a special password requirement, you can also change the password through the button 3; Eighth, the change operation of unlocking password is to use the "4" button to enter; Ninth, press the number key "5" to view the unlocking record; Tenth, in non-administrator mode, press the B button to adjust the display time. In the adjustment mode, press B to switch the adjustment of year, month, day, hour, minute, second and week; After A button is pressed, the relevant data will add up to 1, and C button will reduce a number. Press D button to exit the adjustment mode. Eleventh, if the current interface is not the administrator interface, you need to input the password to unlock. The specific operation process is as follows: First press the C button, check the previous password in the button, delete it after pressing the B button, and delete the password after re-input by pressing the D button. If the password is correct, the door can be opened successfully.

If the above steps do not meet the specified requirements, the program shall be tested again until the program meets the corresponding requirements.

If the above related requirements can meet the premise, then on behalf of the completion of the debugging, can fully meet the corresponding requirements of the design.

5.6. Summary of This Chapter

This chapter mainly introduces the actual welding part and points out what matters should be paid attention to in the welding process. After completing the welding, the next step is to import the program into the hardware and carry out further debugging. In addition, in the follow-up STC-ISP this software specific usage is introduced, the program into the single chip computer to carry out further debugging, and finally the fingerprint, liquid crystal and other hardware part of the debugging is a comprehensive introduction.

6. Conclusions

In this paper, the design of fingerprint identification system is the core of the single chip microcomputer, which uses the hardware including ZFM40 and STC89C54RD+ single chip microcomputer, in order to further improve the stability of the whole system operation link, convenient user operation, so also carry out the key design, can let the user and the system carry out information interaction. The relay can be combined with specific instructions to complete corresponding control and realize the opening function of the door. This paper mainly introduces the core principle of fingerprint recognition, in addition to the analysis of circuit design, using STC_ISP software to complete the program, so as to ensure that the system has a more perfect function.

This design can fully input the relevant fingerprint data in the system, in addition to the process of data input can also be effective identification of the fingerprint number, this system can be fully used in boxes, cabinets, doors and other equipment. The above is the core content of this design. There will also be further improvements to the fingerprint module in the future, and other related innovations need to be applied to it.

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