The Design of Touch Screen Password Lock

Dai Junfeng \(^{1,a}\), Fu Li-hui \(^{2,b}\)

\(^{1}\)Faculty of Electronic Information Engineering, Huaiyin Institute of Technology, Jiangsu Huaian, 223003, China  
\(^{2}\)Faculty of Automation, Huaiyin Institute of Technology, Jiangsu Huaian, 223003, China

\(^{a}\)email: djf0495_cn@163.com, \(^{b}\)email: flh3650326@163.com

Key Words: touch screen, password lock, microcontroller, TFTLCD, XPT2046

Abstract. This design can control 8 locking and unlocking circuits separately. System hardware design adopts TFTLCD 240×400 resolution full-color display, using resistance film pressure sensor and drive chip of the sensor XPT2046 to detect the position of pressure point of the touch screen. System software design can control LCD display operating interface, calculate the coordinate of pressure point of touch screen to realize dynamic arraying of push-button, and unlock by entering password. Whole system can provide three user levels: common user only able to apply for temporary coded lock; on the basis, membership user can have his own separate coded lock; administrator can manage all users, check usage of coded locks, willfully lock or unlock all coded locks. This multi-user multi-level scheme greatly increases flexibility of the system, embodying feasibility and practicability of the system.

Introduction

The touch screen has been integrated into every corner of life[1]. People can get rich information through the screen, and computer can also identify the information that people communicate through the touch of different positions on the screen and various gestures. The touch screen has been recognized as the most natural way of human-machine interaction[2]. In recent years, the words of smart home and intelligent building have gradually entered people's lives, and people have been looking forward to it, and they hope to be able to use such high-tech products. The touch screen password lock is used as an electronic product and controlled by a single chip microcomputer to form a smart home device. The humanized design makes the password lock more flexible and diverse. Users can develop it on their own and use it in all kinds of occasions[3].

This design uses the LCD display circuit and touch induction circuit controlled by STM32 MCU, and the switch lock circuit and gate induction circuit controlled by STC12 singlechip, the system has 8 channels of output, which can control the 8 passwords lock independently, the user can unlock through the input password, when entering the input password interface, the password keys displayed on the touch screen can be dynamically arranged, the user can also set the password. In addition, the design is divided into the user type, the member user and the administrator to meet the needs of various users in different situations.

The overall design

The system is composed of LCD display circuit and touch induction circuit controlled by STM32 MCU, switch lock circuit controlled by STC12 single chip and gate induction circuit, crystal
oscillator circuit and reset circuit. Among them, the STM32 MCU uses STC12C5A60S2, STC12 MCU uses STM32F103C8T6, the LCD display circuit is 40 pin TFTLCD, the touch induction circuit uses the resistance screen, and the special touch chip XPT2046, the switch lock circuit adopts the switch state of the relay model lock, the relay is driven by the driver, and the switch circuit is used to check whether the lock is locked. The system block diagram is shown in Fig.1.

Fig.1 the system block diagram

After reset, the initialization of each module is carried out, then the system starts working normally. The resistance of touch screen in the touch induction circuit will change when the resistance touch screen is touched, which makes the voltage change at the two ends of the resistor. The touch induction chip is converted by ADC to digitize, and is read by the STM32 single chip microcomputer, the STM32 singlechip converts this information into a specific coordinate position, and compared it with the current interface, then the name of the touching control is judged, the name of the control and current interface are sent to the STC12 singlechip by the serial port. The STC12 singlechip, through the name of the control and current interface, jumps to the position of the program that needs to be executed. When the switch state of a password lock needs to be changed, the corresponding electric potential of the pin is controlled. When changing the contents of the touch screen, the corresponding instructions are sent to the STM32 microcontroller through the serial port. The closing induction circuit is used to inform password lock state to the STC12 microcontroller.

The Design of STM32 main control circuit

The main control circuit of STM32 uses STM32F103C8T6 as the core, including crystal oscillator circuit, reset circuit, power filter, and LCD display circuit and touch induction circuit, the OSC_IN, OSC_OUT and 8M oscillator are used to produce a certain baud rate synchronous clock signal in the serial communication, and the frequency of 72M can be supported by frequency doubling. The capacitor in the diagram plays the role of stable oscillation frequency and fast starting vibration. The capacitance value is generally 20-50pF. Between the power source and the ground, 0.1uF capacitors are used to filter and provide a stable DC power supply for the single chip microcomputer. To meet the minimum system requirements, 1, 24, 36 and 48 pins are connected to the power supply, 8, 23, 35 and 47 pins are grounded, and 68 pin is grounded by pull-down resistors. PA0-PA15 are connected to the 16 bits data parallel port of TFTLCD, the PB3-PB7 is connected to the TFTLCD control end, in which the PB3 is connected to the LCD_CS, the PB4 is connected to the WR, the PB5 is connected to the WD, the PB6 is connected to RS, and the PB7 is connected to the RST. PB11-PB15 is connected to the XPT2046 control terminal, in which the PB11 is connected to the CLK, the PB12 is connected to the CS, the PB12 is connected to the DIN, TX and RX are connected with STC12 microcontroller serial RXD and TXD respectively.
the design of STC12 main control circuit

The STC12 main control circuit uses STC12C5A60S2 as the core, including the crystal oscillator circuit, the reset circuit, and the switch lock circuit and the gate induction circuit. The diagram is shown in Fig.2.

![Fig.2 the main control circuit diagram of STC12](image)

The RST pin is connected to the reset circuit of the single chip microcomputer. Generally, if the high level of 10us is kept, the single chip can complete the reset, but in order to ensure the system to reset reliably, the reset circuit should keep the high level of the pin RST above 10ms. The P1.0-P1.7 port of the microcontroller are connected with the 8 switch lock control circuit, the P3.4 is connected with the gate induction circuit, the 31 pin is connected to EA.

the design of touch induction circuit

The touch sensing circuit uses XPT2046 as the core, and its detailed wiring diagram is shown in Fig.3. 1 feet is connected to VCC, 9 feet is connected to Vref, 10 feet is connected to VCC, 6 feet GND, 7 feet IN3 and 8 feet IN4 are connected to ground, 2 feet X+, 3 foot Y+, 4 feet X-, 5 feet Y- are connected to 16, 15, 14,12,16 feet CLK is connected to PB11 which is used to receive SPI communication clock signals, 15 feet CS is connected to PB12 which used for chip selection, 14 feet DIN is connected to PB13 which used for SPI communication serial input, 12 feet DOUT is connected to PB14 which used for SPI communication serial output, the 11 pin keeps high level, and when the touchscreen is touched, the 11 pin becomes low, STM32 microcontroller can detect whether there is touch screen touch event by detecting the high and low level of the 11 pin. If the touch screen hits the event, by the SPI port, the microcontroller first sends the command 0X90 to read X coordinates, then reads the data of 2 bytes, then sends the command 0XD0 to read the Y coordinates, reads the data of the 2 bytes, at this point, the coordinate value of XY is known.
the design of switch lock circuit

The switch of the lock is realized by the switch of the relay, as shown in Fig.4, designs a 8 way switch lock circuit. The I/O represents the input terminal of the 8 way switch lock circuit, which is controlled by the P1 port of the STC12. Because of the limited driving ability of the MCU I/O port, the driving circuit of the relay is needed. The driving circuit controls the base of the transistor by the I/O port of the microcontroller, and controls the connection between the collector and the emitter by the output level of the single chip microcomputer. When the triode is connected, the current flows from the power through the current limiting resistance into the relay, and flows into the ground to form a loop. The relay coil is absorbed. When the triode is closed, the relay coil does not flow through the current, and the relay has no action.

Fig.4 the switch lock circuit

the design of gate induction circuit

Close door induction circuit, as shown in Fig.5. I/O is connected to the P3.4 pin of STC12 microcontroller. In order to meet the people's use of the lock lock, the lock should be closed automatically when the door is closed. At this point, the microcontroller needs to be able to receive the closing action. This design is realized through key buttons. When the door is closed, the button will touch the key, the key is pressed, the single chip microcomputer I/O port's potential is pulled down, the MCU reads the low level. When the door is not closed, the key is not pressed. At this time, the I/O port of the single chip is pulled up by the pull resistance, and the single chip computer reads the high level.

The conclusion

The users of the touch screen system are divided into three types, namely, ordinary users, member users and administrator users. The three types of users have different user rights. The user's rights are different, and the configuration of the administrator to the whole system can be improved greatly. The design can be used as a supermarket locker, multi-person apartment lock, express cabinet and many other places, and can be changed by the administrator users according to the different actual needs, so that the product is more close to the daily practical habits of people.

Reference
