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Original Research Article

A Design of Automatic Check-in Terminal Based on Fingerprint Recognition

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Abstract: In order to solve the problems such as easy loss of paper tickets, no recycling and waste of resources, an automatic check-in terminal system based on fingerprint recognition is designed. We develop and improve the existing fingerprint identification module, and using fingerprint reader to collect the fingerprints and store them in the database. Fingerprints information can be substituted for paper tickets, baggage, reservation, boarding pass printing and other functions. When passengers book tickets, fingerprints will be collected. When the passengers collecting tickets at the airport, the system will check the fingerprints, confirm the tickets, and print the boarding pass. At check-in, the fingerprint can be reconfirmed for safety. In order to ensure the safety of passengers information, the system will send the boarding pass information to passengers through the form of a short message.
Keywords: Fingerprint identification, ARM, Check-in, SMS.

INTRODUCTION

With the construction of digital airports, check-in terminals are becoming more popular [1]. At the same time, a large number of paper tickets were discarded, the country will produce nearly a hundred tons of paper waste each year, resulting in serious environmental pollution and a lot of waste of resources [2]. In addition, many airport ticketing systems use the method of reading the card number and entering the password to verify the identity of the passenger, this traditional authentication technology is not safe, and the password is easy to forget, the card is easy to lose, that may cause some management problems, and resulting in airport security management loopholes. At present, the third generation of biological radio frequency fingerprint identification technology has been quite mature. The recognition rate of radio frequency fingerprint identification technology for sweaty fingers and other difficult finger can reach 99.8% and it only response to the body's living skin dermis [3]. This technology can prevent fake skin and the price is relatively low. Therefore, using radio frequency fingerprinting technology for airport digital construction is a reliable solution to solve these problems.

When booking tickets, the fingerprint information of the passenger is collected and encrypted, then stored in the airport information system. When the passenger using the fingerprint identification terminal in the airport, by comparing the fingerprint characteristics stored in the system, the identity of the passenger can be confirmed, and then the operations such as boarding pass can be printed..

HARDWARE MODULE SELECTION

System Overall Structure

The system overall structure is shown in figure 1.

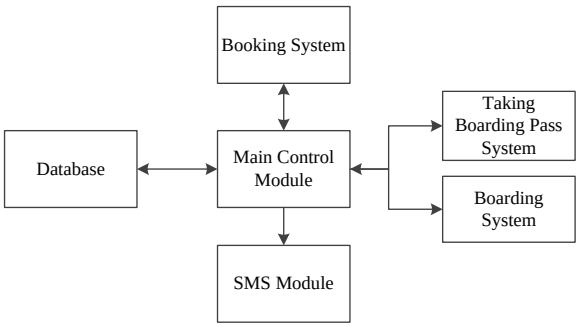

Fig-1: System overall structure

Database: used to store the user's fingerprint, identity, flight and other personal information.

Ticketing system: for the ticket order, collecting fingerprints and other necessary personal information.
GSM SMS reminder system: after the passenger booking, sends the ticket booking information.

Get boarding pass system: for getting a boarding pass.
Boarding confirmation system: used to confirm boarding.

Control Module

Control module using STM32 processor as the main controller. STM32 memory includes 64KB to 256KB flash memory and 20KB to 64KB embedded SRAM. Select ARM series STM32F103 as the main chip, the chip has a very rich memory and a relatively sufficient I/O port, which fully able to meet the needs of this design [4]. The data processing power of STM32 processor is relatively high than other processors, which can greatly improve the efficiency of program. STM32F103 processor power frequency is 72 MHz, the operating voltage is about 3.6 volts. The internal configuration of the power saving mode greatly reduces power consumption. That can meet the power requirements and balance the performance and power consumption.

Power Supply Module

In order to make the system more practical, taking into account the redundancy, economic and other factors, we use dual power supply. One is 220V mains supply, through the transformer and rectifier, convert to 3.6 V, that can meet the design requirements. The other one is the system internal battery power, through a buck chip, making the voltage drop to 3.6 V, as the emergency power supply.

Display Module

Display module using a LED digital tube and a touch color display in conjunction. Digital tube is a display screen which can display numbers and letters. By controlling the input current of different pin, its corresponding pin will be light or off, then it can display the numbers and letters that you want. Digital tube is very simple to use, but cannot display Chinese characters. The display of TFT touch screen is more realistic, more colorful and more visual effects [5]. Its display response time is generally less than 80ms, the corresponding time that the screen display needs are also greatly reduced. In addition, its control does not require additional key assistance, which is very convenient to use.

SMS Module

This design uses the GSM module to realize the short message reminder function. Send and receive text messages is one of the most important functions of GSM. Using mobile networks as the technical support, the system can achieve timely and convenient passenger reminder services. With the continuous development and improvement of the GSM network, SMS has become more and more popular. GSM network in the environment of human life is basically no blind spots, and SMS has the characteristics of mandatory push to ensure the accurate delivery of information. In addition, using GSM network to send a short message is more flexible. Further more,it can be universal, low-cost and cost-effective.

THE SPECIFIC DESIGN OF EACH MODULE

Main Control Module

Figure 2 is the control module circuit diagram of check-in terminal system. The main chip is ARM series STM32F103, which is a low price and the performance can meet the needs.

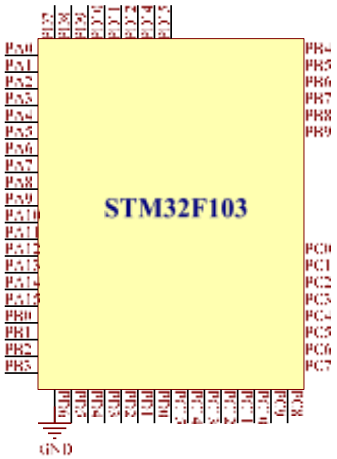

Fig-2: Chip of STM32 F103

Power Supply Module

As shown in figure 3. The system uses dual power supply. One power supply is 220V dropped by the transformer, then after the bridge rectifier circuit and LM7805 regulator module, the voltage dropped to 3.6V to meet the system needs. The other power is the system internal 12V battery power, which dropped by the DC-DC depressurization power supply module LM2596 to 3.6V [6]. The internal battery charging device is always connected to the main power supply to ensure that it remains fully charged state at all times. When the main power supply is de-energized, the system can be powered by internal power supply, so that it can still work properly.

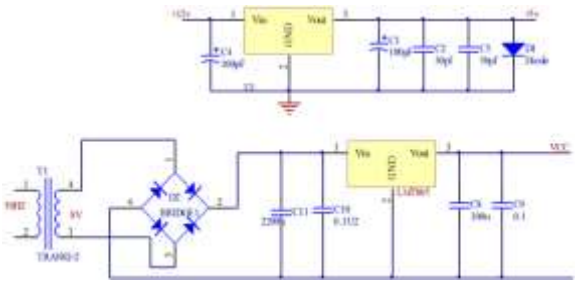

Fig-3: Power supply module

Display Module

The design uses dual display of TFT touch screen and digital tube. The design TFT touch screen is relatively complex. The LCD we choose is TFT-LCD24TP, LCD control chip is ILI9325, touch-screen control chip is STMPE811. When design touch screen display, we should pay attention to the conversion of the GRAM coordinates and LCD screen coordinates, and set the LCD display mode. Because the hardware has been designed, so ILI9325 chip must use the SPI interface. The phase and polarity of the clock signal are important, and this determines which data captured by the output signal is valid from the beginning. Mainly is the setting of the clock phase, CPHA is set to 1, SCK will be sampled on the second edge, so that the data will be latched at the edge of the second clock. If CPHA is reset to 0, the SCK will be sampled on the first edge and the data will be latched on the first clock edge.

SMS Module

This module uses the Siemens TC35i GSM module to achieve SMS notice function [7], as shown in figure 4. TC35i is a dual-band 900/1800MHZ highly integrated industrial-grade GSM module to support Chinese short message. TC35i has low power consumption and stable performance and is an ideal solution.

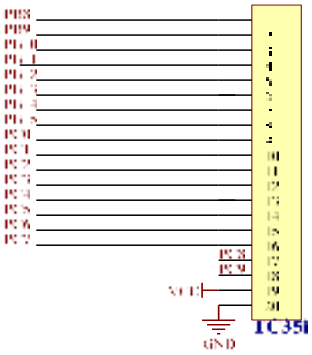

Fig-4: GSM SMS Module

System Overall Circuit Diagram

The overall circuit diagram of the system is shown in Figure 5.

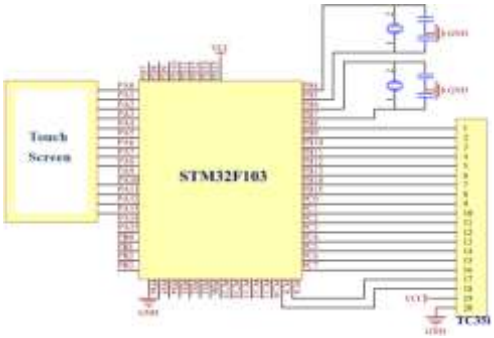

Fig-5: Diagram of system overall circuit

DESIGN OF SOFTWARE

According to the idea of modular design, the functions of the system can be divided into several tasks, each sub-task is achieved by the corresponding subroutine. Including the booking system, ticket collection system and boarding system, etc. Each subroutine will be integrated through the main program, then the system can achieve booking, boarding pass print, boarding and other functions.

Booking System

When passengers order tickets in the terminal, they need to pay first, and fingerprints were scanned into the database, in order to facilitate tickets collection and boarding. The flow chart of booking system is shown in figure 6.

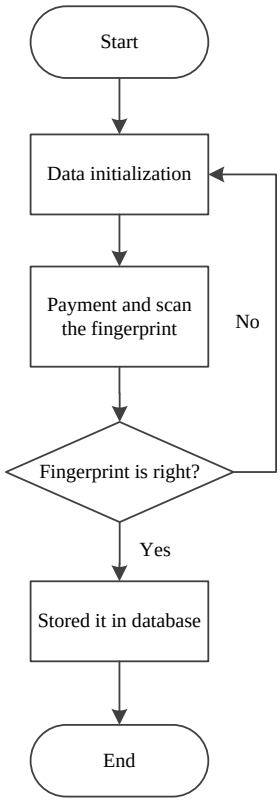

Fig-6: Flow chart of booking system

System of Taking the Boarding Pass

At the check-in terminal, the passenger is first fingerprinted and the fingerprint will be compared with the fingerprint in the database. When the information is confirmed successfully, you can do the operations such as seat selection, check your luggage, print boarding pass and so on. You will also receive a short messages notice. The flow chart of taking the boarding pass is shown in figure 7.

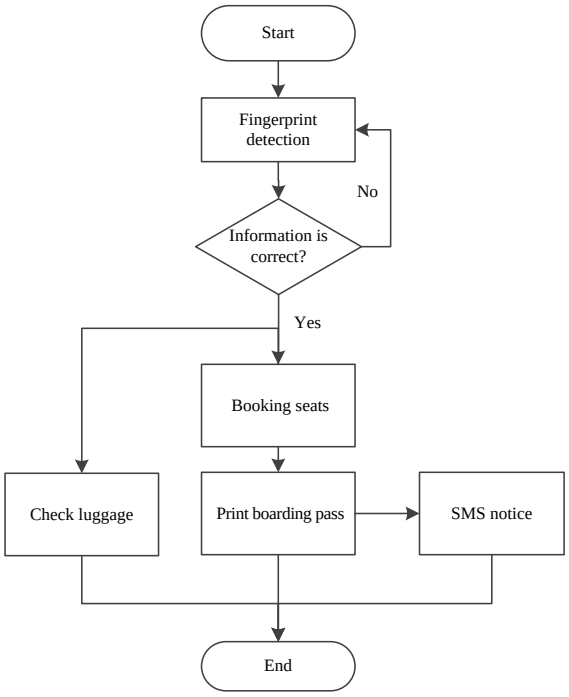

Fig-7: Flow chart of taking the boarding pass

Boarding System

When boarding, the fingerprint information and boarding pass information will be checked again. When the information is confirmed correct, you are allowed to board. The flow chart of boarding system is shown in figure 8.

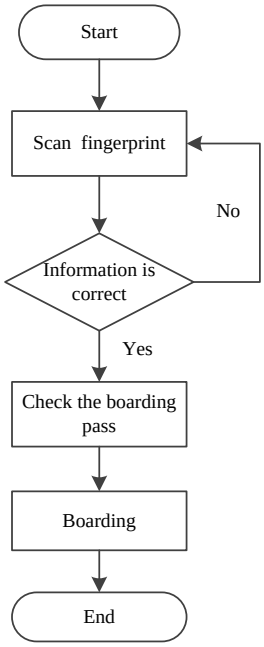

Fig-8: Flow chart of boarding system

System Overall Flow Chart

We combine the subroutines, obtain the flow chart of the overall system, as shown in figure 9.

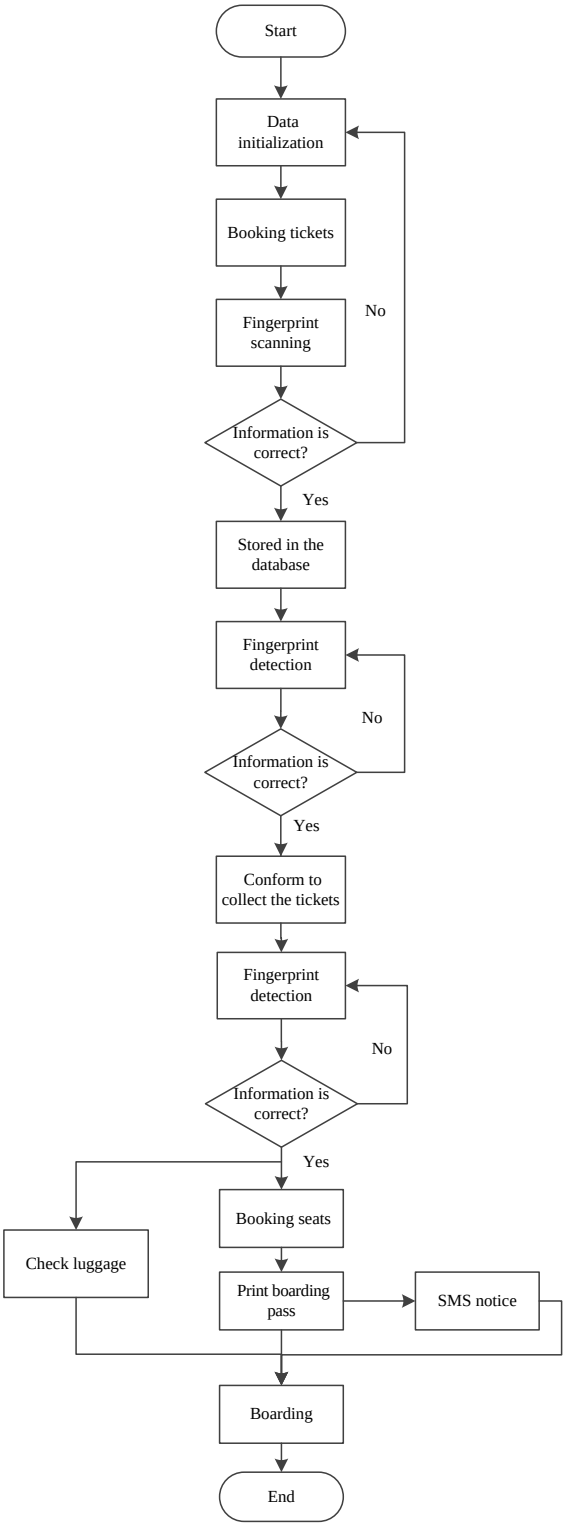

Fig-9: Flow chart of the overall system

CONCLUSION

The fingerprint check-in terminal system, using ARM as the main controller, which can achieve real-time scanning, booking, ticket and other functions. The system has a high degree of automation, scientific algorithm and high security. Passengers can choose the operation keys on the soft keyboard to realize the operation of each function. That is easy to learn and use and greatly reducing the labor cost. In the programming, In the design of software, the system uses the C language programming and modular programming methods. Each program module is independent of each other, which is easy to run and debug.

Innovations

A. Reduce the use of paper tickets and saving resources.
B. The complexity of human fingerprints makes it can be used as features of the official identification, then fingerprint can effectively reduce the occurrence of information leakage and improve passenger information security.
C. Higher security, avoiding someone uses counterfeit information boarding.
D. We can use dual fingerprints recognition, when an accident, the backup fingerprint identification can be used. The design is more user-friendly and more convenient to use.

Some Questions

A. Database design needs to be optimized to ensure storage efficiency.

B. Online information security needs to be guaranteed.

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