

Design of Campus one-Finger Service System Based on Fingerprint Identification

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Abstract—In order to solve the problems of RF card that easy to lose, not recycling, waste of resources and so on, we using human fingerprint feature instead of RF card, designed a campus one-finger service system based on fingerprint identification. Integrating RF fingerprint identification technology to the digital campus system, to achieve the goal of multiple uses of fingerprint identification. We made some improvement of the existed RF fingerprint recognition module and designed a fingerprint recognition consumer terminal device based on STC processor, through a fingerprint reader to collect the teachers' and students' fingerprints and stored in the database. The STC processor real-time scanning, when a fingerprint is scanned, it will be compared with the database, if the match is successful, and the "Check button" outside is pressed, it will perform recharge or deducted operation and display the account balance. The terminal device using dual power supplies to ensure the reliability of the system. It is connected to the host computer through RS-232 interface and thus connects to the campus one-finger service system. This system has important significance for the construction of low-carbon society.

Keywords—fingerprint identification; digital campus; terminal; single chip microcomputer; check button

I. INTRODUCTION

RF card is commonly used in the campus. Depending on reports, only in 2013, China had about 11 million high school graduates and about 700 million college graduates. If half of high school students and 80% of college students hold RF card, then the RF card discarded each year will produce about 70 tons of e-waste, cause environmental pollution and waste a lot of resources. The primary purpose of this design is to reduce the problems that caused by the extensive use of RF card, starting from the teachers' and students' daily life, closely linked to the energy-saving and emission reduction. With continuous advances in information technology, digital has become the direction of the industrial development and the construction of one-finger service system based on fingerprint identification is of great significance for green digital campus construction.

II. DESIGNING BACKGROUND OF CAMPUS ONE-FINGER SERVICE SYSTEM

Fingerprint recognition is a biometric identification technology, has the generality of all common biometric identification, merely the object analyzed is the fingerprint

characteristics [1]. Among all biometric identification used for individual identification, the fingerprint feature is the first to be discovered and applied, so the fingerprint recognition technology has a longer history than other recognition technology and more mature. Since the 1970s, there began an automated fingerprint identification system, after 40 years of development, the current fingerprint recognition technology has been widely immersed into people's life and work, to be accepted and widely used in the field of attendance, access control and security, etc.[2].

With the construction of digital campus, as an important carrier of campus one-card service system, most of the campus provide RF card, but as students graduate every year, a large number of RF card is discarded, and then will produce nearly 100 tons of e-waste, pollute the environment and cause a lot of waste of resources. In addition, the current campus one-card service system generally adopted the methods of reading the card number and inputting password, etc. to identify the student identity. However, this traditional authentication technology is not secure, for the password is easy to forget and the card is easy to lose, so it will cause some management problems.

Currently, the third generation RF fingerprinting technology is already quite mature [3]. The recognition rate of this technique for sweaty fingers, dirty fingers and other difficulties can be up to 99%, and it only reaction to real human dermal skin, had strong ability to anti-fake fingerprints and low prices [4].By using RF fingerprint recognition technology instead of RF card and applying to the campus integrated management information system, we can efficiently solve such problems.

III. FRAMEWORK OF CAMPUS ONE-FINGER SERVICE SYSTEM

Campus one-finger service system using fingerprint as an information carrier, and it is a system engineering building on the network, the basic structure as shown in Figure 1.

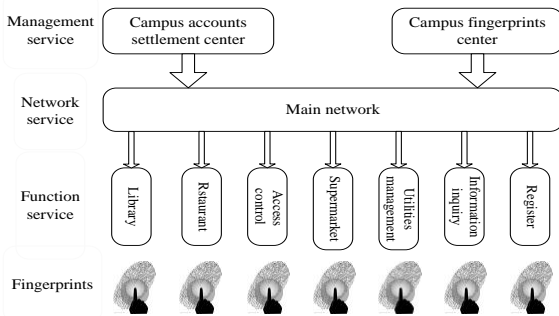


Fig. 1. Framework of campus one-finger service system

This design integrating RF fingerprint identification technology to the digital campus system, constructing an information resources sharing platform that based on the campus network and makes separate functions or department information together [5]. Through fingerprint recognition technology to recognize the fingerprint as electronic identity carrier so that teachers and students can conveniently complete such as book lending, attendance and consumption that all activities related to its own identity [6]. In campus, using fingerprints instead of student ID card, library card, access control card, meal card and other kinds of cards, can make users easily use and improve school management efficiency and reduce costs.

A. Campus Accounts Settlement Center and Fingerprint Center

Campus accounts settlement center and campus fingerprint center are the two functional departments of Campus one-finger service system. Campus accounts settlement center communicate with the terminals through online or offline (by smart card etc.) mode to achieve information data acquisition, statistics, settlement and reconciliation or divide up money with the charging units etc; Campus fingerprint center is mainly responsible for fingerprint acquisition, registration and the account data entry (such as recharge) and fingerprint information rerecording, log out, etc.. The basic information of all personnel data will be shared real time in the network, so that all the data changes will take effect immediately.

B. Selection of Network

Network is the maintenance of campus one-finger service system. The transmission medium of the network can be cable, optical fiber, infrared and electromagnetic wave, etc. [6]. It basically has the following two implementation way.

- Using the existing campus network platform. The advantage of this method can make full use of the existing campus network, utilizing the existing network resources, less investment and short construction period. The disadvantage is due to the relative freedom and openness of the campus network, it will suffer a greater risk from the school network hacker attacks, and its security assurance is difficult. Through firewall settings and taking a variety of high intensity data encryption technology, and partitioning virtual local area network scientific and reasonable to the network level and regional, is the effective ways to improve the network security.

- Set up a private network. Establishment of an independent private network for campus one-finger service system may need large investment, but the data through a dedicated private network encryption transmission can ensure the security of information transmission and is a better solution. Private network connected with the campus network through a firewall to provide a query function for campus network. Connected with the bank through a router or DDN special line can realize real-time unionpay service provided by the bank. The private network trunk lines can use 10/100 MBPS switch and protocol converter connecting to RS-458 network. Form a dual network structure that the upper is 100 MBPS Ethernet private network and the lower is RS-485 network for original service data acquisition and forwarding..

C. Fingerprint Identification Terminal

Fingerprint identification terminal is an important part of campus one-finger service system, the fingerprint identification terminal that real contact with the users not only occupies a large proportion in the project investment but also greatly influence the normal operation of the whole system. Therefore, the selection or development of fingerprint identification terminal is one of the most important content for the one-finger service system construction.

IV. DESIGN OF FINGERPRINT IDENTIFICATION TERMINAL

We design a consumption terminal based on fingerprint identification technology using STC IAP15F2K61S2 single chip microcomputer, the diagram of the system structure as shown in figure 2.

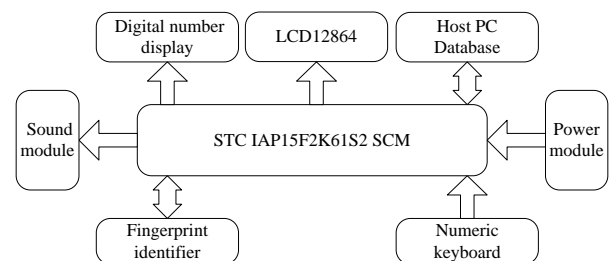


Fig. 2. Diagram of consumption terminal system structure

We use STC IAP15F2K61S2 single chip microcomputer as the main processor and improve the existing RF fingerprint identification module [7]. Through the fingerprint recognizer collecting the teachers' and students' fingerprints, and stored in the database. The STC processor scanning fingerprints real time. When a fingerprint is scanned, the fingerprint information collected will be compared with the information which stored in the database, if makes a successful match and the consumer press the check button, then process recharge or deduction and account information is displayed at the same time.

The program flow chart of consumption terminal as shown in figure 3.

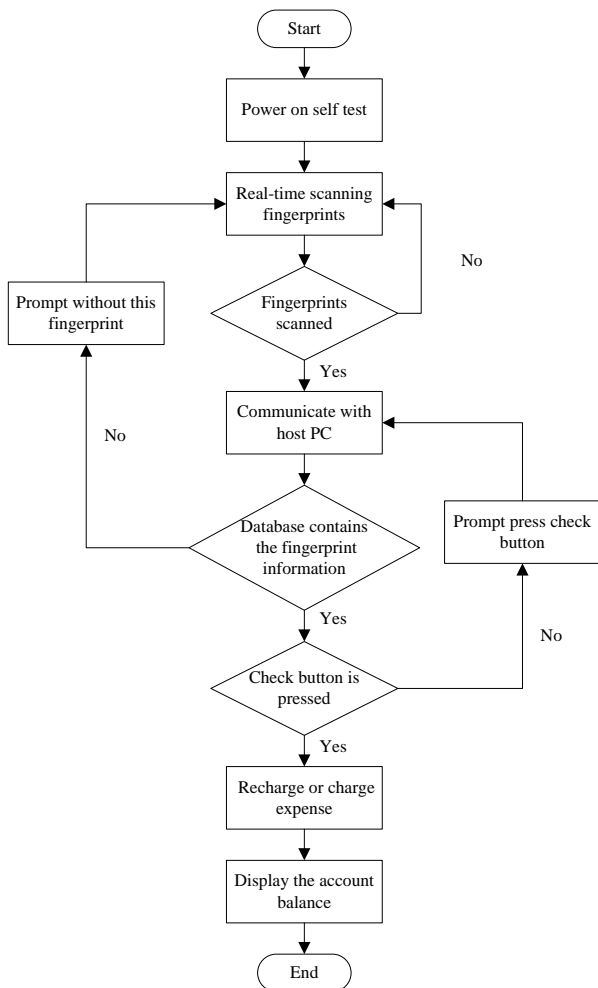


Fig. 3. Program flow chart of consumption terminal

The main circuit diagram of consumption terminal as shown in figure 4.

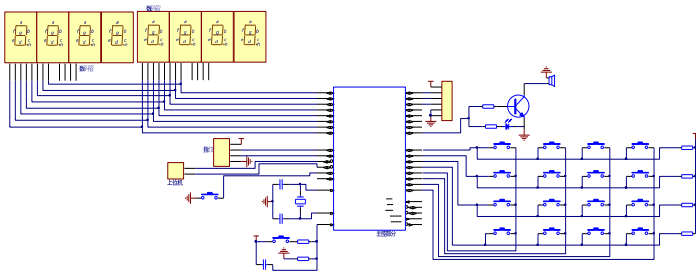


Fig. 4. Main circuit diagram of consumption terminal

A. Keyboard Module

The terminal back including ten number keys, an enter key and a cancel key. When press the number keys corresponding to the corresponding numbers, Continuous press could accumulate, until reach the needed amount, then press the enter key, can be deducted; Two single keys combination (means press key two at the same time) can achieve query the front four consumption amount and the total amount consumption today, etc..

The terminal front is an independent key namely Check button, when fingerprints were collected the check button effect to prevent wrong operation and improve the accuracy.

B. Display Module

The terminal back has a LCD12864 display, it can use serial operation [8], not only save IO port but also has the characteristics of convenient operation, display a large amount of information, low voltage and low power consumption.

The front is a digital number display. Although it cannot display lots of information and cannot display Chinese characters, but its display function is sufficient to meet the requirements, and has higher brightness, showed more eye-catching.

C. Power Module

This system uses dual power supply, one is 220V by transformer and bridge rectifier module, etc., so as to convert to 5V, to meet the needs of the terminal. The other one is an internal battery power supply that through a three-terminal voltage regulator module called LM7805, makes the voltage drop to 5V. When the main power supply outage, the system will be automatically replaced by the internal power supply, make it can work normally when power loss. The design of power module circuit as shown in figure 5.

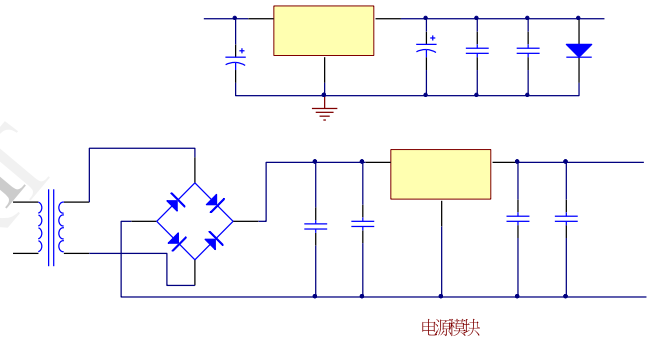


Fig. 5. Design of power module circuit

D. Communication Module

When the fingerprints acquisition and storage, the MCU will upload the information to the host PC database and storage; when a fingerprint is scanned, the MCU will obtain data in the database and then compare. If it matches and the check button is pressed. Recharge or deduction operation will be executed and the corresponding information will be uploaded to the host PC and stored. The serial port communication circuit between terminal and host PC is shown in figure 6.

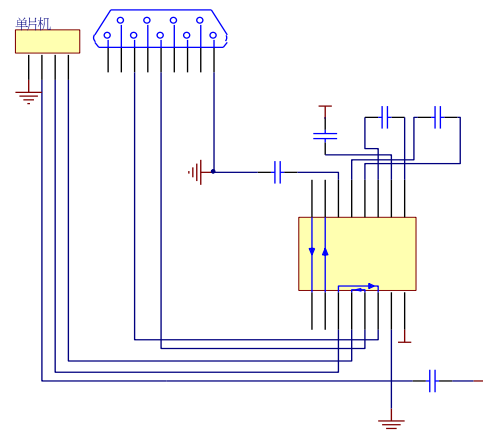


Fig. 6. Serial port communication circuit

E. Terminal Appearance

Design of the terminal appearance as shown in figure 7.

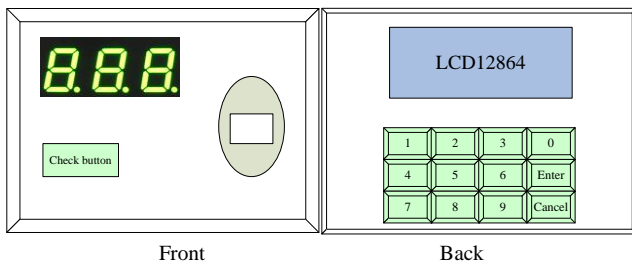


Fig. 7. Design of the terminal appearance

V. CHARACTERISTICS AND INNOVATION OF THE SYSTEM

Using fingerprint identification technology to replace the campus RF card and building a campus one-finger service system, can greatly reduce RF card usage, easy to manage all types of information about students and teachers. Start small, saving energy and protecting the environment. At the same time, avoid the series of problems of RF card such as loss, theft, reports the loss, post-register and so on.

In addition, this system also has the following characteristics.

- Fingerprint is uniquely human characteristics, and its complexity is sufficient to provide enough features for identification; therefore using fingerprint recognition technology can effectively reduce the funds stolen, improving account security.
- Using dual authentication of fingerprints and check button, through the check button makes the system more secure.
- When collecting fingerprints, double fingerprints information can be collected, when an accident the spare fingerprint can also identify. Therefore, the design is more humanized and user-friendly.
- When the design improved, user can also set a password and use both the fingerprint and password to protect the security of the account. Fingerprint information can bind with bankcard and can be convenient for recharge through fingerprint and password.

VI. CONCLUSION

For school management, the campus one-finger service system can enhance management effect, improve work efficiency, reduce workload and make full use of school resources, reduce unnecessary waste. For users, the multi-use of fingerprint can greatly facilitate the teachers' and students' working, learning and living in the campus. The security performance of fingerprint identification technology and sound management system can maximum protect the interests of teachers and students.

In this paper, we propose a campus information management solution that combined fingerprint identification technology with campus working and life styles. Which can greatly improve the campus information management level, effectively prevent unauthorized users from theft of personal property and greatly improve the security of the campus network system. The popularization and application of this system is of great significance to energy conservation and green digital campus construction.

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