



Design and Realization of Intelligent Attendance Management and Control System Based on Fingerprint Identification

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Abstract: This essay devotes on designing an intelligent attendance checking system based on the fingerprint collected from a highly sensitive fingerprint sensor to compensate for the lack of small and medium-sized enterprises rapid attendance system. There are three portion of this system: multi-function attendance checking machine, intelligent management and control software, access control system. Using the collected fingerprint and information gathered from IC card, together with other Internet technique like RFID, image processing and TCP/IP, features such as attendance checking and upload the attendance record and statics are available. Proposed system which supports searching and inserting attendance records of large quantities uses advanced programming language for instance C# and Android, and has a user friendly human-machine interaction interface providing simple and straightforward operating steps. Repeat professional experiments several times, it shows that the system can identity people real-time, correctly, rapidly and stably.

Keywords: fingerprint identify, RFID, Attendance Inquiry

1. Introduction

Whether in enterprises, schools, scientific research institutions or hospitals and other fields, to achieve standardized management and efficient work, attendance system has always been the core part of the management system. For enterprises, the fairness and rapidity of employee's attendance are very important and directly affect their work efficiency, attitude and enthusiasm, and even cause indirect damage to the enterprise benefit, image and culture; For school attendance system is also used as the standard

to judge students enthusiasm and objectively reflects the learning enthusiasm degree of the students and teaching levels of the teachers. At the same time, it can investigate students' comprehensive quality and teachers' teaching ability. So the speed and accuracy of attendance is very important [1-2]. With the development of networking technology and the birth of the concept Internet plus that is developed by our country, office automation has also gradually improved; at the same time, along with the rapid development of economy, enterprise scale is gradually expanding. The increasing number of required accuracy, security, efficiency and economy make a great challenge to the existing attendance system [3]. Therefore, it is very necessary to develop a set of efficient and accurate intelligent attendance management system.

With the progress of science and technology, especially the rapid development of hardware integration, as the core of attendance system, attendance machine identification also shows the development of diversity, including the common RFID card attendance, attendance, attendance, fingerprint recognition, iris recognition face recognition attendance, speech identification of attendance and other forms [4]. There is a single way of attendance that is easily degaussed, insecure, vulnerable to external interference, expensive, slowly recognized. Besides, it cannot take the speed, accuracy, stability and security in one and is not suitable to the demand of the market which tends to be more a way of identifying binding modes [5]. The traditional appraisal system mainly adopts the non-contact attendance (RFID Technology), biometric technology based on attendance (fingerprint, voice, and gait recognition), camera attendance (face and iris recognition) and combines with them to attend. Due to non-contact attendance that maybe causes wrong attendance replaced by others, the biometric technology problems to be improved, the camera attendance that costs a lot of time and expensive, To realize rapid and accurate attendance is in need of improvement[6-7]. In addition, the traditional attendance that has only a single function, can only query and export reports function through the computer and has single function. It cannot realize remote query and record attendance data and cannot timely find and feedback abnormal attendance data and others; the attendance system in the market, there are few functions that is used to evaluate personnel working attitude scientifically through attendance data. Therefore, the market is in need of a high precision and powerful intelligent attendance identification solutions.

To solve the above problems, this design combines embedded and advanced networking technology, based on the hardware platform which is take the advantage of RFID smart chip and DSP chip which can fingerprint identify quickly, and to the PC terminal and the mobile terminal as a software platform, construct a set of efficient, accurate and powerful intelligent fingerprint attendance management system, which

can realize the attendance statistics, access control system management, mobile terminal remote real-time check attendance records and other functions.

This system has very good market value. What's more, it possesses properties such as accuracy, security, efficiency, economy and mobility, which can be well applied to different occasions to satisfy the requirements of attendance and access control for enterprises, schools, hospitals, driving and other users by providing an efficient accurate and powerful intelligent fingerprint attendance recognition solutions.

2. The Whole Framework of Intelligent Fingerprint Attendance Management System

Intelligent fingerprint attendance management system is composed of multifunctional fingerprint attendance instrument, intelligent control software and access control system. The multifunctional fingerprint attendance instrument through network, follow the TCP/IP protocol conducts two-way communication with intelligent control software, and through checking instrument controlled by I/O communication relay action and access control system. At the same time, the intelligent control software through network, follow TCP/IP protocol and communication, access control system indirectly [8]. Among them, the multi-functional fingerprint attendance instrument has a strong recognition accuracy, and which is using advanced fingerprint algorithm and three identification methods of identification, including fingerprint identification, RFID identification, and dynamic password identification.

The multi-functional fingerprint attendance instrument through the fingerprint identification module and RFID identification module to acquire user's information about fingerprint, high-frequency card data identification and other's authentication information, which ensure to read user's information quickly and accurately. Moreover, the intelligent control software by the end of the remote PC attendance management software and Android APP attendance query software, and PC software has the same device settings with the upper end of the attendance, which follow established data protocol and in order to realize data interaction through the network connection. Android mobile phone APP attendance query software, by connecting the wireless LAN, can also interact with the attendance instrument data, mainly for remote query and management of attendance data for users. As to the access control system mainly connect with the intelligent fingerprint attendance instrument by network, which can set user's jurisdiction in attendance instrument and realize access control attendance by controlling the opening and closing and alarm functions.

The overall framework of intelligent attendance management system is shown in figure 1:

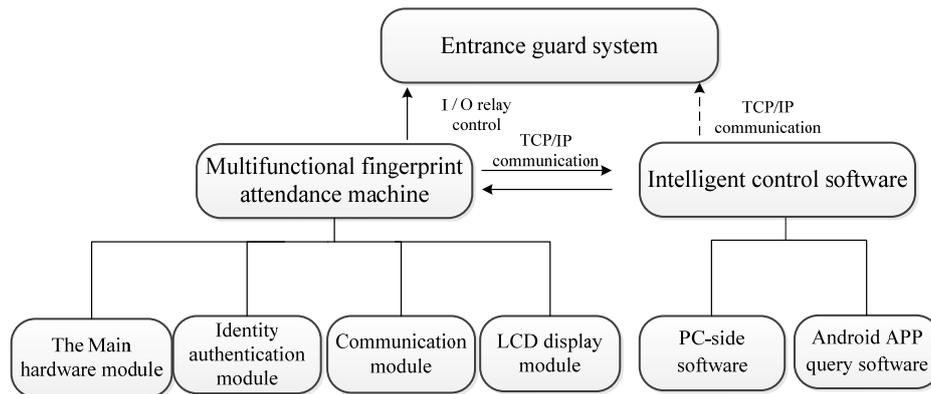


Fig.1 Frame diagram of the system

3. System Hardware Design

The multi-function fingerprint attendance instrument includes the main part of the attendance machine, identification module, communication module, LCD display module. It has the advantages of accurate identification, low power consumption, easy installation, easy operation and good human-computer interaction. System hardware architecture shown in Figure 2.

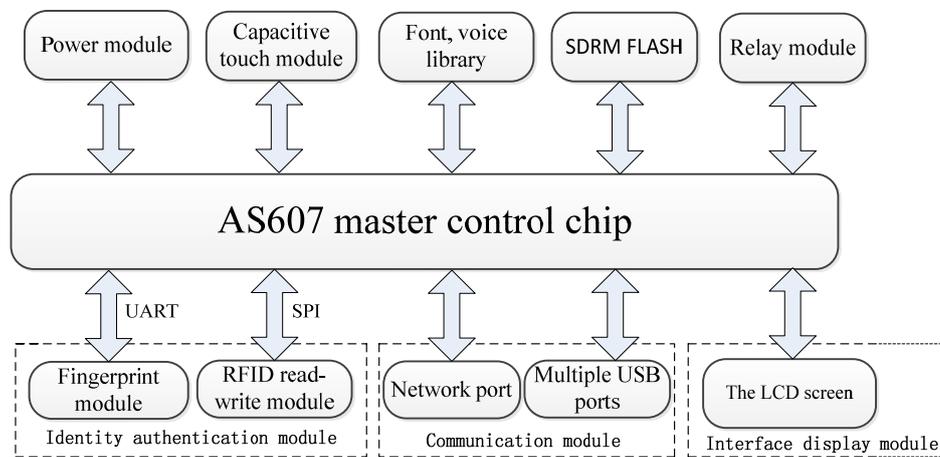


Fig.2 Frame diagram of the system hardware

3.1 Design of the main part of the attendance recorder

The main controller of Multi function fingerprint attendance recorder (MCU) is designed by AS607 chip. It has high performance DSP operation instruction, support DSP floating point operation and including fingerprint algorithm accelerator. To ensure the normal

operation of equipment, the power supply module uses 12V DC power supply and the main chip uses 3.3V power supply. Through the A/D acquisition, capacitive touch module wakes up MCU from the low power state. Font, speech database provide two languages, Chinese and English, which can realize intelligent voice reminding function. The SDRM module can ensure attendance machine running smoothly; the FLASH module is used for storing program data, user information, and attendance information to avoid losing data. In addition, through the way of UART and SPI communication, the main part of the attendance recorder achieves data transmission with identity recognition part of the fingerprint and RFID. Through the network port and multiple USB interfaces, the main part of the attendance recorder communicates with the upper control software and the compiler; the LCD color display mainly used to guide the user operation display user information, set parameters and GUI friendly design, which enhance the user experience and the ability of human-computer interaction.

3.2 Identity authentication module

Identity recognition module mainly includes three parts. There are fingerprint identification, RFID card identification, dynamic password identification.

(1) Fingerprint identification

The master chip of main control of AS607 is the Cordis 6+ RISC processor core, which has 7 stage pipelines and branch prediction function. The chip has a unique Synochip hardware accelerator and a unique fingerprint algorithm accelerator, which support DSP floating-point instructions. In order to eliminate phenomenon of false fingerprints, we use a capacitive semiconductor fingerprint sensor RT1011 acquisition based on planar dermis to ensure the safety, accuracy and rapidly of fingerprint acquisition[9]. Through the SPI serial communication mode, the fingerprint identification module uses the main control chip AS607 and the RT1011 fingerprint sensor to realize the fingerprint data transmission; AS607 has multiple UART. It uses the UART0 control the fingerprint module and sends data request instruction to UART0 according to the communication protocol. Then the RT1011 sensor will transmit fingerprint data to the main controller AS607. Through the processing of fingerprint optimized accelerated algorithm, AS607 can generate fingerprint feature points as shown in Figure 3[10]. According to the communication protocol, UART0 sends a set of instructions, which can realize the operations of image acquisition, fingerprint feature point generation, fingerprint characteristics matching, feature point combination and feature template generation. So as to realize user fingerprint input, alignment and recognition and other operations. In this system, as the main attendance identification method, the fingerprint identification achieves the function of fast authentication and

recording the personnel information through acquiring the user's fingerprint information and storing the user template.

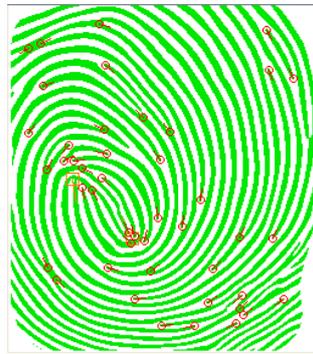


Fig.3 Points of fingerprint feature extraction

(2) RFID Recognition

RFID Recognition, an alternative method of identification, can be used for identity authentication and registration via swiping ID card and the high-frequency IC card. The THM3010 reader chip used in RFID control chip is a multi-protocol non-contact reader chip according with the ISO/IEC14443 TYPEA and ISO/IEC15693 standards, which is mainly applied for contactless reading and writing of 13.56MHz IC card[11]. Figure 4 shows the RFID core read-and-write circuit. The module exchanges data with AS607 via the SPI serial communication. The AS607 is the master of SPI and THM3010 is the slaver. By adjusting the length of PCB antennas and the value of filter capacitance and inductance, the sender module is capable of delivering data with far distance (up to about 10cm), and the receiver module can receive and process the data of IC card accurately by applying the reliable receiving decoding circuit[12]. By tuning parameters like antennas, capacitors and inductances, the system can read ID card and data of general IC card at the same time. Thus it can ensure the rapidity and authenticity of attendance.

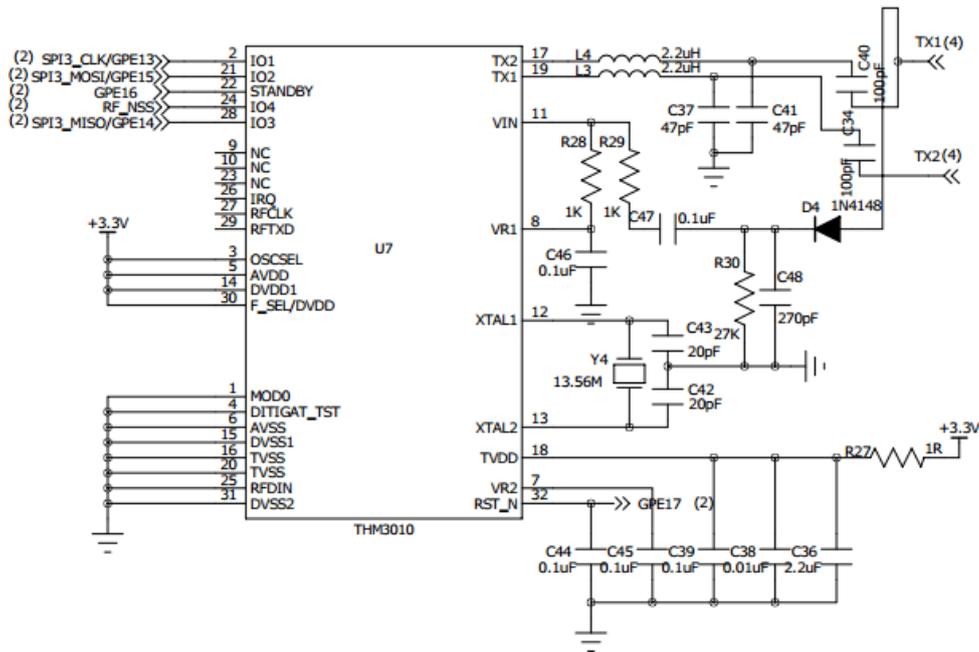


Fig.4 RFID core reading and writing module circuit

(3) Dynamic Code Identification

As fingerprint and RFID card are both failure, Dynamic code identification is an alternate means for identity recognition via inputting dynamic password to identifying and registering. Because of the access control function of this attendance machine, this method is mainly used to control access actions in case of failure of fingerprint and card losing. Compared to the static password, the dynamic passwords which consist of eight numbers during 0 to 9 are more safety and reliable. In order to ensure the randomness of passwords and increase the difficulty of cracking code, we use time as cryptogram, thereby every dynamic password is different with each other. The core algorithm is based on the shift operation, which implemented by applying the CRC calibration cycle encryption. Both of the APP of mobile phone and the attendance machine are set the same original passwords of eight numbers. And it is necessary to calibrate the time to guarantee the consistency of the time. On the basis of the original passwords, the dynamic password is generated via using current time by means of encryption algorithms. The algorithm used in APP of mobile phone is consistent with that used in attendance, which generates the equal dynamic passwords at the same time. Just generating dynamic passwords via mobile phone, you can realize the recognition and authentication of identity and control the access actions.

3.3 LCD interface display module

The attendance device equipped with color 2.8-inch TFT LCD screen, with PS, GUI Convert Bitmap and other software to improve the fingerprint attendance interface style, more beautiful and practical; interface-based optimization, the system is also extremely powerful. The interface display mainly includes the boot interface, low-power standby interface, menu interface and its sub-interface, in which the menu interface and its sub-interface is particularly important, mainly functional settings and operation.

Main menu interface mainly have seven functions, including user management, communication settings, information query, data management, system settings, time settings and automatic detection . User management, including ordinary users and administrators of the registration, registration and delete users, methods include fingerprint, credit card and dynamic password; communication settings, including the machine number, communication, baud rate settings, TCP / IP settings. The TCP / IP settings include IP address, subnet mask, gateway, port settings, and server IP settings. Information query mainly include storage of information, you can query attendance records, the number of users and other information; Data management, the main data can be downloaded, U disk upload and download attendance data and offline update system program features; System settings, including the attendance record settings, access control settings and language settings, The access control settings, including the duress fingerprint function, once the user is intimidated, press the duress fingerprints, it will trigger the alarm device to remind someone to enter illegally; Time setting, mainly used to set the time and date of the attendance machine; Automatic detection function, used to detect whether the work attendance is working properly, whether the data transmission is normal, communication is normal and other functions.

4. System Software Design

4.1 The Overall Structure of System Structure

The intelligent control software consists of the attendance management software for PC and the query software for Android APPs, using C#, SQL server and JAVA Android as programming languages, in order to efficiently achieve several functions, such as data storing, querying, synchronizing, etc. Specifically, JAVA Android is mainly used for the development of Android APPs, to implement the function of inquiring attendance

record and controlling access. The structure diagram of the intelligent control software is shown in Figure 5.

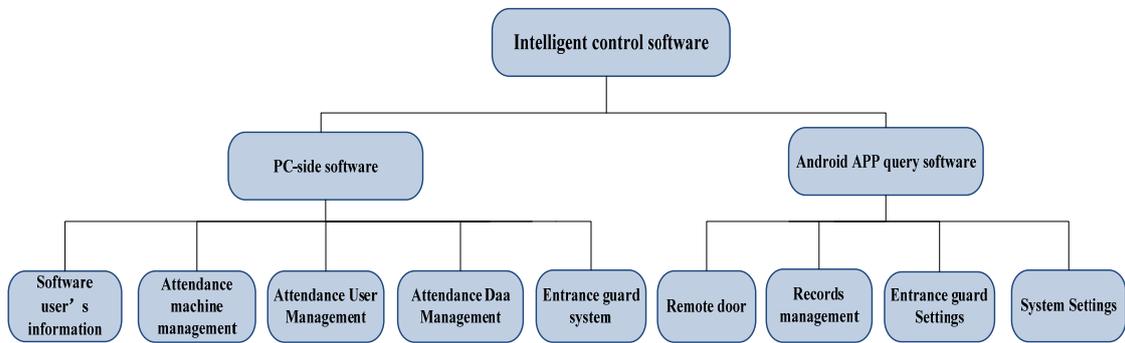


Fig.5 System function structure diagram of software module

4.2 The Design of Attendance Management Software for PC

In consideration of practicality, efficiency and user experience, the attendance management software is designed modularly, which includes 5 modules: Software User Information, Equipment Management of Attendance Machines, Attendance User Management, Attendance Data Management, and Access Control System Management. Additionally, the exchange of data between one another, between the modules and the multifunctional attendance machine, and between the modules and the access control system is achieved through LAN, conforming to TCP/IP protocol. The main process of the attendance management software is shown in Figure 6.

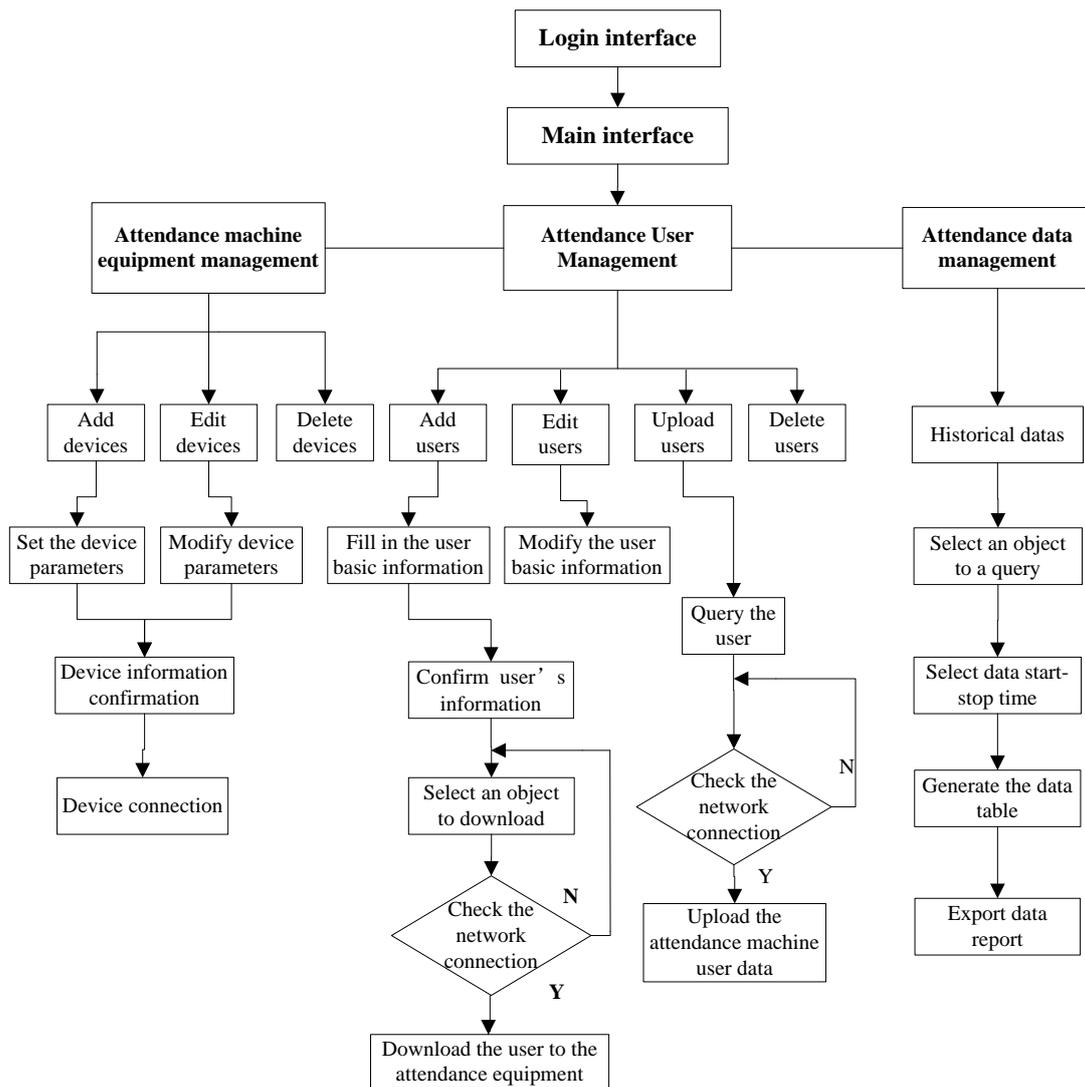


Fig.6 The flow chart of attendance management software in the PC

Specifically, “Software User Information” module is the management of the personnel who are capable of operating the management software (they are administrators in general), which includes registering, password login, deleting, modifying and other functions. “Equipment Management” module includes setting and modifying device number, device name, communication mode, IP address, communication password, device port, etc. It can be used to manage multiple fingerprint attendance machines, such as adding, editing and deleting devices, aiming to exchange information between attendance machines. “User Management” module is the management of registered users in the device. When the network is under good conditions, it is used to achieve user editing, deleting, clearing, inquiring and other functions, including querying user basic information, user number, user type, the number of fingerprints, etc. “Attendance Data Management” module can be used to

upload attendance record, query, export Excel spreadsheets, set the attendance time and identify abnormal attendance, etc. Besides, inquiring attendance data and exporting reports are rather important. For the purpose of creating a user-friendly platform, attendance reports can be exported in the ways of either "time" or "personal", before analyzing the data, sorting and summarizing. "Access Control System Management" module is used to record the data of opening the door and control the access control system.

4.3 Android APP query software

The software uses the modular design idea, uses the humanized interactive contact surface and makes the different functions encapsulate some sub modules to facilitate the software module mutually to call and the optimized data processing speed[13]. The specific process shown in Figure 7.

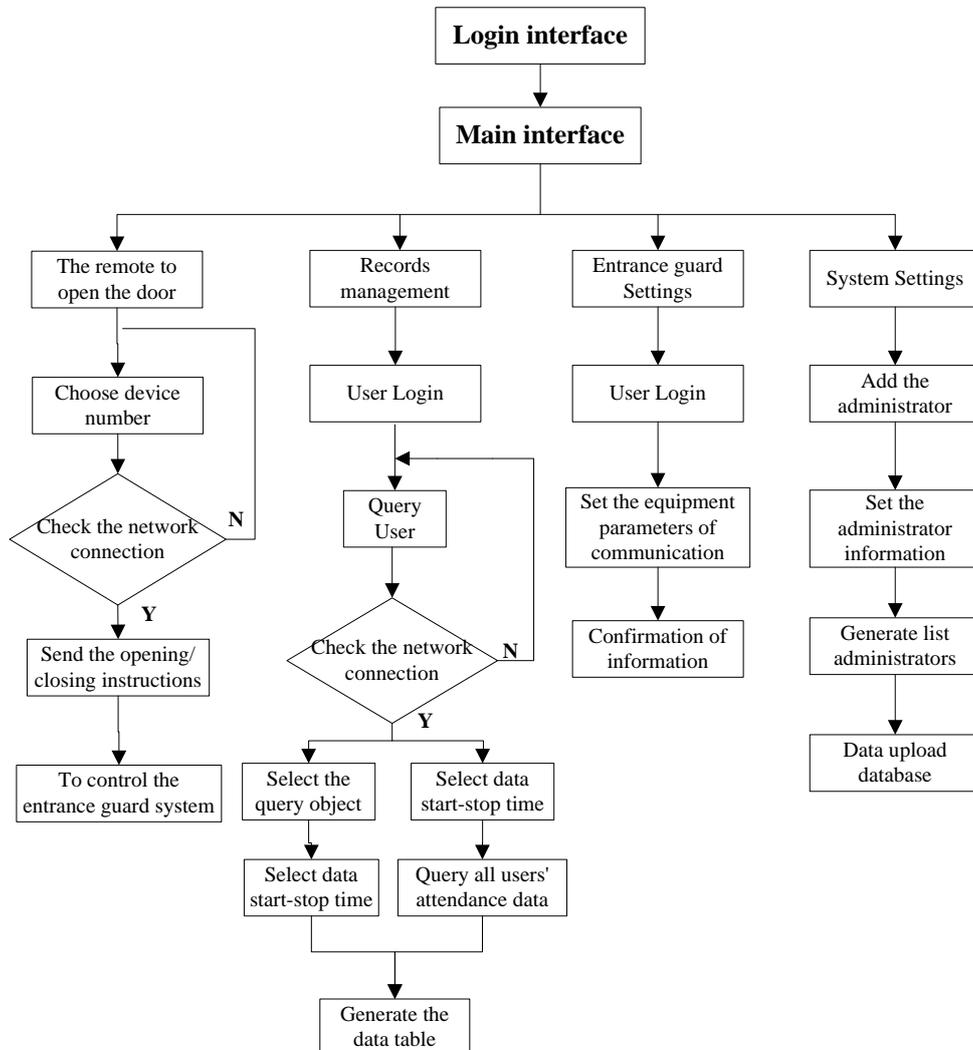


Fig.7 The flow chart of query software design in the mobile

The software main interface right from top to bottom is divided into four modules, including remote door, record management, access control settings and system settings. Remote door-opening function; when the phone through the settings, in the WIFI or broadband network environment, connects to the LAN and then through the TCP/IP communication protocol and the established protocol exchanges data, It can realize remote control attendance relay action and then control the access control switch; Records management includes the access to attendance data and query attendance data. Access to attendance data is that access to attendance information of LAN multi-function fingerprint attendance. There are two ways of data query, one is a fixed time for all attendance and the other is to specify the user's attendance data; Access control settings, mainly for communication settings, includes the server IP address, communication port number, communication password and device serial number; system settings module is mainly for APP software users to register, login, set password and other operations, and the operating authority is generally administrator privileges .

5. System implementation

The system provides a good solution for the small and medium enterprises' quick attendance record statistics.



Fig.8 PC-side software main interface

After adding the devices, setting up the communication settings and connecting LAN, the PC-side software can realize the data interaction with the attendance machine. The main interface show in figure 8. The software can read user lists and attendance data in the equipment. Besides, there are also users' ID, attendance date, attendance methods and other basic data in the equipment. By clicking on the User Management button, the user can upload, delete and download the PC's data to the device. By clicking on the attendance data management button, you can query the user data in the specified time and make data statistics, rankings and attendance reports.



编号	日期时间	状态	操作
00008	2016-10-20 18:03:02	正常	指纹操作
00019	2016-10-20 18:04:00	正常	指纹操作
00020	2016-10-20 18:04:09	正常	指纹操作
00013	2016-10-20 18:04:14	正常	指纹操作
00014	2016-10-20 18:04:16	正常	指纹操作
00015	2016-10-20 18:04:19	正常	指纹操作
00016	2016-10-20 18:04:20	正常	指纹操作
00012	2016-10-20 18:04:23	正常	指纹操作
00011	2016-10-20 18:04:25	正常	指纹操作
00010	2016-10-20 18:04:30	正常	指纹操作
00001	2016-10-20 18:04:32	正常	指纹操作
00002	2016-10-20 18:12:25	正常	指纹操作
00002	2016-10-20 18:12:28	正常	指纹操作
00018	2016-10-20 18:29:44	正常	指纹操作
00017	2016-10-20 18:30:27	正常	指纹操作
00002	2016-10-20 18:31:24	正常	指纹操作
00017	2016-10-20 18:32:33	正常	指纹操作
00001	2016-10-20 20:28:49	正常	指纹操作
00009	2016-10-20 21:50:07	正常	指纹操作
00002	2016-10-20 22:44:23	正常	指纹操作
00002	2016-10-20 22:48:15	正常	指纹操作

Fig.9 Hardware main interface Fig.10 Attendance data query interface

If companies need the employees' attendance records, the company need to use the multifunctional attendance which shown in figure 9 under the administrator permissions for the user. There are three ways which are fingerprints, IC cards and passwords to register. After completing the registration, the user set up the equipment's communication settings according to the company LAN IP address. At last, The user can implement attendance device connected to the company local area network (LAN). In addition, with GUI programming technology, the attendance machine users can change the subject of machine according to the personal willingness to increases the users' experience. After setting up the settings of system and connecting the fixed IP address, Android APP query software, as shown in figure 10, can realize real-time remote view attendance data in a given attendance machine. The attendance data include attendance personnel number, attendance date, attendance time and other attendance data. In addition, PC software and android APP can control

the entrance guard system in the remote area and provide a good solution for the access control attendance integration.

6. Conclusion

For the realization of large-scale fast and accurate user attendance identification, registration and query function, the article design the fingerprint-based intelligent attendance management system. The system is based on the precise fingerprint recognition algorithm. And it realizes the user through fingerprint, IC card rapid registration and identification of identity functions. With the advanced Internet of things and embedded technology, it realizes the function of data exchange between the remote PC and the end user. The user can query, manage and analyze the attendance data through the PC terminal and the remote terminal in real time, and realize the historical attendance data. The system has multiple I / O outputs and a very good scalability. It can connect the entrance guard system and dock with intelligent household. After a number of companies to actually run the test proved: The system has good accuracy, stability, rapidity and very good practical value. Besides, it has a very good market value.

Acknowledgements

This paper was financially supported by Major Project of Beijing Municipal Education Commission science and technology development plans (KZ201510011011), Innovation ability promotion project of Beijing municipal colleges and universities (PXM2014_014213_000033) and NSFC under Grant (No.51179002). Those supports are gratefully acknowledged.

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