

# New Intelligent Access Control System

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**Abstract.** The development of technology in fingerprint identification and anti-theft system of smart lock, has become quite mature. The article started with research on remote control, visitor identification reminders, emergency open, and setting different doorbell in different situations. Developed a matching mobile Android APP to realize remote data communication with door lock. The system calls Tencent Cloud Face Recognition API to complete face verification and recognition. The semi-active RFID module can be used to open the door without physical contact within 2 meters. The basic configuration and related functions of the door are completed using the fingerprint recognition module, camera, and LCD screen. The functions to be implemented in the article are all in good operation during the actual debugging process.

## 1 Introduction

In 2015, BAT these three companies start to launch smart city services in several cities. In 2016, a number of leading heavyweight companies in China began to research and develop smart home products. In 2017, research in the field of next-generation artificial intelligence such as big data, cloud computing, and deep learning is rapidly evolving. Machines capable of self-learning will begin to listen, see, speak, and even think.

The research and development of family door locks is in line with the development of the era technology. Smart door locks have also experienced four generations of rapid development, from the first generation of smart screen fingerprint locks, to the second generation of SMS butler locks, and to the third generation of cloud smart locks, now to the fourth generation of AI Cloud smart locks begin to develop. Family door locks, as the entrance products of smart homes, have a great market prospect and become the next major research hot spot. The current rapid development of smart homes, smart door locks, as a key member of it, its development focused on fingerprint security unlock, remote control door opening and intelligent security management, however, there is still a huge space for the development of intelligent functions and services for home locks [1][2].

## 2 System Overview

The overall block diagram of the system and the Android client architecture are shown in Figure 2.1 respectively [3].

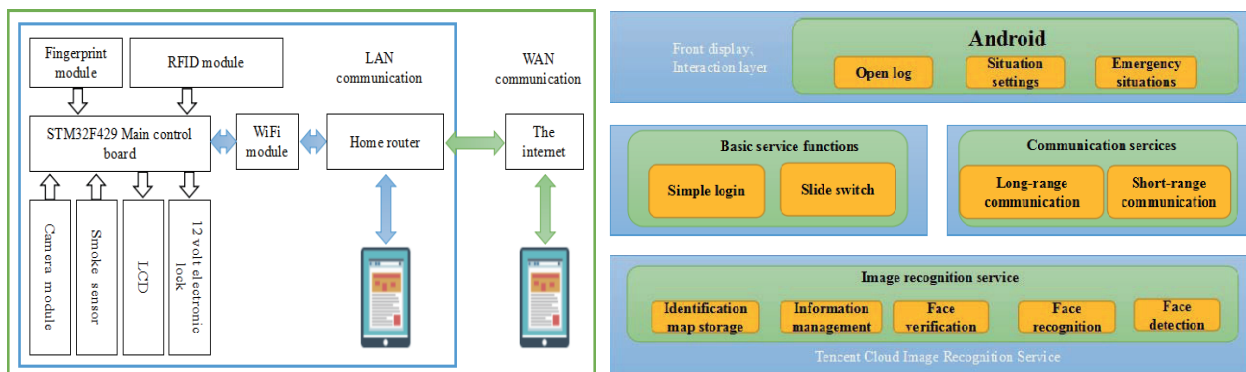


Figure 2.1 Overall system block diagram and Android client architecture

### **3 System Function Realization**

In order to realize the later development of the function, the system selected the STM32F429 series as the core processor.

#### **3.1 Communication Function Implementation**

Short-range communication. In the STA+AP mode, the AP serves as a TCP server and the module sends a WIFI signal. Send AT+RST to restart the module and send AT+CIPMUX to start multi-connection and start network communication. Send AT+CIPSERVER=1,10000. After the TCP server is started, the Server listener is automatically established. When there is a client access, it will automatically occupy one connection in the order[4].

The mobile phone or emulator needs to connect to the WiFi signal sent by the module. Then first create a Socket object in the Android client code. `Socket socket = new Socket("192.168.4.1", 10000)`. After running, the two parties can establish a connection. After the mobile client obtains the output stream (`socket.getOutputStream()`), it wraps the OutputStream into a print stream and sends the related character information to the hardware (Server). After the hardware receives the character instruction, it can execute the related operation. Get the input stream (`socket.getInputStream()`), convert the acquired character stream to the byte stream, and read the response information from the hardware side by line.

Telecommunication. In the STA+AP mode, the STA serves as the TCP client. The hardware connects to the home router as the device. The port number is still 10000. The home router on the connection will randomly assign an IP address to the system hardware. This IP address is passed through the software peanut shell to implement mapping of the internal network port, and the internal network IP is mapped to the external network. The mobile client program only needs to change the IP address and port number in the Socket to the peanut shell domain name and the temporarily assigned port number that were applied to, and the two parties can communicate after running. In telecommunication, the user can access and control the hardware system in the home through the peanut shell domain name at any location where the Internet is accessible.

#### **3.2 Emergency Treatment**

In the emergency processing interface of the APP, after the user clicks the button, the mobile phone APP will also send a door opening instruction to the hardware system while completing the corresponding short message sending and number dialing. After the hardware receives the instruction, it will open the door urgently.

The selected smoke sensor has a high sensitivity to the detection of natural gas, and can also be applied to the detection of multiple gases such as household smoke and gas.

#### **3.3 Induction Door to Achieve**

The non-contact induction door opening function within 2 meters is mainly divided into three steps. First, after the key end enters the 2-meter sensing range of the 125KHz transmitting antenna structure at the reader end, the key-end 125KHz wireless receiving chip will receive the correct trigger signal and wake up its main chip. The key-side control 2.4GHz wireless transmitter chip sends its own ID and control command data to the reader. After the reader-side 2.4GHz wireless receiver chip receives the correct data, the two parties can realize the connection. Finally, the reader side sends a door opening control message to the relay unit through the serial port unit to realize the door opening without physical contact.

#### **3.4 Basic Function Implementation**

##### **3.4.1 Fingerprint Module**

The built-in DSP operation unit of the AS608 fingerprint recognition chip integrates sophisticated fingerprint recognition algorithms to complete high-speed processing of complex fingerprint images. 0.3 seconds rapid identification. error rate is less than 0.001%.

##### **3.4.2 Camera Module**

ATK-OV5640 camera module is a cost-effective 500W high-definition camera. The module supports image quality control, image compression, digital video interface, and various image output formats such as RGB and JPEG.

## 4 System Software Design

### 4.1 Excellent Face Recognition Interface

At this stage, the realization of the project function "smart visitor reminder" and the face recognition part is achieved by calling the "Tencent Cloud" intelligent image service face recognition interface.

The project realizes the transfer of captured face photos to the computer's corresponding folder. The Eclipse platform is programmed to upload photos online to the cloud face database. After the recognition or verification is completed, the response information is returned. The request body size is limited to 2MB and the request method is Post. The specific implementation process is as follows:

A. First, the Group information management interface is invoked to create an individual, add a face to each individual, set related information, etc., and delete operation may also be performed. The number of faces that each individual can establish is limited to 20.

In this step, the individuals to be verified and identified are uploaded to the cloud database. Each individual uploads 5 to 10 "different" photos and completes the corresponding creation. These photos just need to edit the corresponding name, do not need to do preprocessing.

B. The system can call related function functions and write corresponding codes to send a face verification or face search request to the cloud.

C. If the returned response information is correct, in order to perform the project-related functions, the response information is further analyzed layer by layer to obtain the required response information.

### 4.2 Android Client Design

The system's Android APP has a total of 5 interfaces, as shown in Figure 4.1 below. The open log interface, multiple context ring setting interface, emergency processing interface, and expansion interface are four main interfaces, and a similar effect of switching between the WeChat interface can be achieved between them.

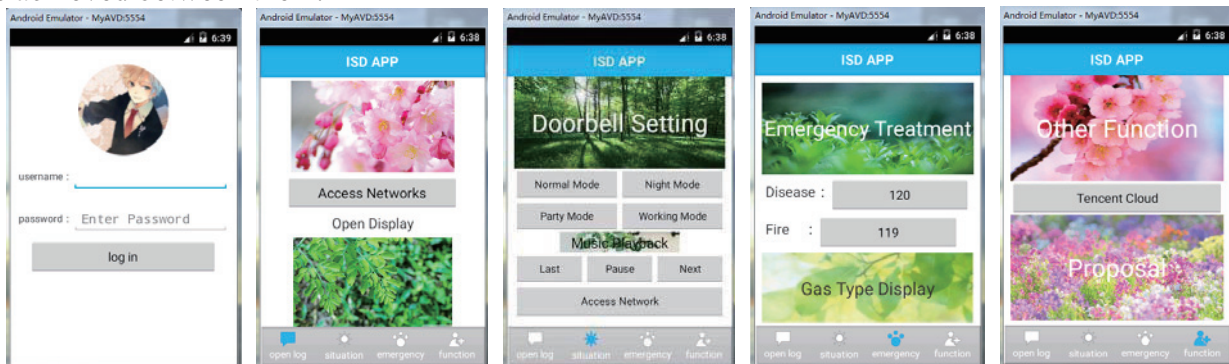


Figure 4.1 Android client interface design

Use the ViewPager+FragmentPagerAdapter method. Each TabLayout interface corresponds to a Fragment to display its own layout content, making great use of mobile screen resources. Compared to the simple method of using the ViewPager method in the initial method, the code in the MainActivity is prevented from being too verbose. The respective controls and responses exist only in their respective Fragments and are easy to view and manage.

## 5 System Function Debugging

### 5.1 Short-range and Long-distance Communication Debugging

Ensure that the mobile phone APP and the WiFi module are in the same WiFi condition, and both parties can implement data transmission. As shown in Figure 5.1 below, the hardware side can receive the character control information from the mobile phone APP as shown in the figure "IPD, 1, 1, 2", interpreted as the client No. 1, and one character is transmitted. The character is 2. After receiving the character information, the corresponding operation can be performed. The door opening

information "The door has opened" from the hardware side can also be displayed in real time on the log opening interface of the APP.

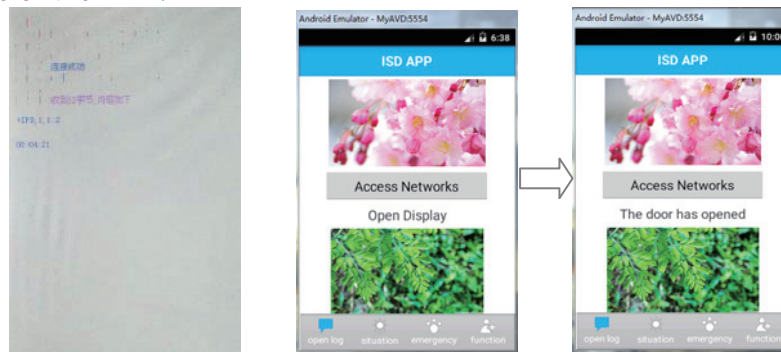


Figure 5.1 Communication function effect display

After completing Penetration by the Peanut Shell software, the IP address assigned by the home router for the hardware module is bound to the domain name purchased by the project. Direct access to the domain name in the APP enables remote control of the home smart door lock. The effect of long-distance communication is the same as that of short-range.

### 5.2 "Emergency Handling" Function Debugging

First of all, in the emergency handling interface of the APP, after pressing the "120 Emergency" button, the interface will jump directly from the APP to the SMS interface. As shown in the figure, the content of the SMS (Address+Family+jibing) has been edited in advance[5]. Press "119 emergency" button, the interface will jump directly from the APP to the dial-up interface, the user just click once to complete the SMS and number dialing.

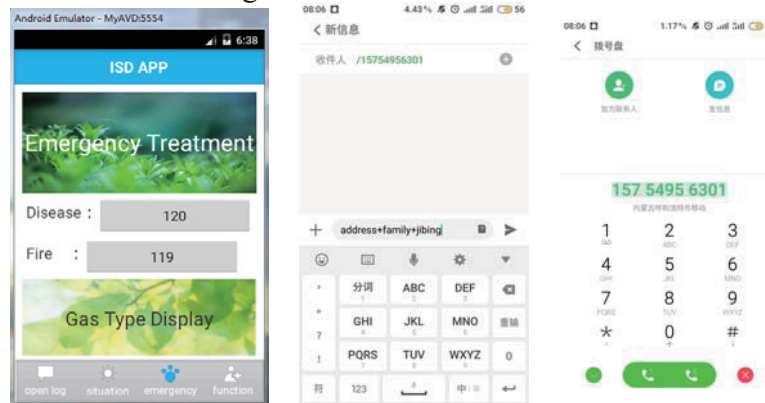


Figure 5.2 shows the effect of "emergency handling" function

Then the implementation of the hardware side, the threshold is set very low during the test. When it is detected that the gas concentration in the environment exceeds the threshold, the door will be opened in an emergency and the buzzer will sound to show the alarm.

### 5.3 "Induction Opening" Function Debugging

The induction door is divided into two parts for debugging. The first is the close-range recognition function debugging, as shown in Figure 5.3 below. When the sensor key is about 3cm away from the reader, the door can be opened inductively, and the 10cm identification distance of the manual cannot be realized. Then the door is opened within 2 meters. When the test object is within 2 meters of the door body, the door can be opened without physical contact.

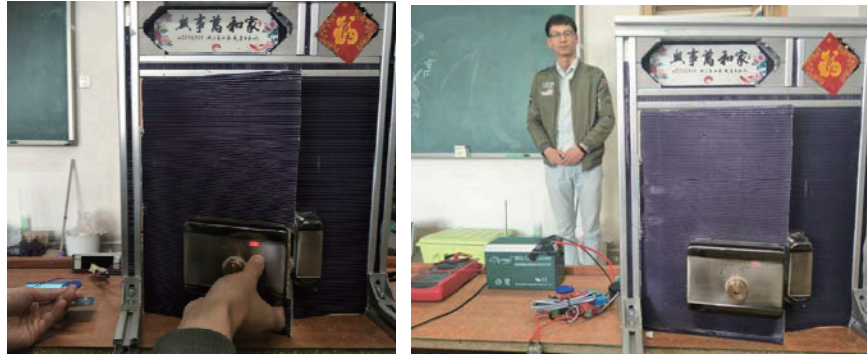


Figure 5.3 Effect display of "induction door opening" function

#### 5.4 Basic Functions of Door Lock

As shown in Figure 5.4 below, the camera module in the lower left corner can be directly inserted on the main control board, and the image outside the door captured by it can be clearly displayed on the LCD screen. The LCD screen will be placed in the door. The fingerprint identification module can be opened after the user's brushing fingerprint recognition is successful. The related user fingerprint addition management can be achieved.

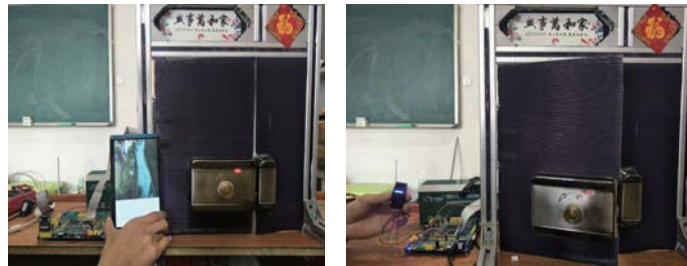


Figure 5.4 Effect display of the basic function of the lock

#### 5.5 Identification Results Display

Upload images in the folder online to the cloud face database. After the face recognition is completed, the returned response information will include the five candidate's ID number, face image number, similarity, and label definition. After the face verification is completed, the response information will include the degree of similarity and matching of the uploaded user photos with the user photos in the face database. By further parsing the response information, the values of confidence and ismatch are obtained.

#### Conclusion

The functions proposed in the initial stage of the project have been well tested through actual tests, but the system still has the following two problems: First, the handling of emergency situations, failure to handle due to triggers caused by mistakes, and whether emergency open doors should be provided in case of household gas leakage. There are still many practical problems in the handling of emergencies. The second is the intelligent visitor notification function. Although the face recognition interface is called, the images collected by the camera are not directly uploaded to the cloud face database. The client speech synthesis has not been successful, the system needs further improvement.

#### Acknowledgement

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