Design and Research of Smart Home Terminal Based on Android Platform

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Abstract. In recent years, the system of traditional home hasn’t fulfilled people’s pursuit of a higher quality of life requirements. Smart home is a big trend in the future development. For the Android open platform for intelligent terminals, in order to integrate Wifi, 3, 4G and other communication technologies for the home gateway as the core control center, remotely control to lighting, electrical appliances, security, monitoring as the representative of the home terminal equipment design and research of smart home terminal system is necessary. In this paper, design and research are based on Android phone of smart home terminal control system. It has been proved well that the user is able to control household appliances by Android application remotely.

Introduction

Smart home is a residential as a platform, integrated wiring technology, network communication technology, security technology, automatic control technology, audio and video technology. Smart home aims to build an efficient management system for residential facilities and family affairs. Nowadays, the Internet of things, cloud computing and other concepts provide a strong technical support for the rapid development of smart home. Android open platform Google launched quickly occupied most of the market share of smart mobile phone system. Android has become a public platform that be recognized by the whole industry. The combination of the smart home and the mobile Internet is a dramatical revolution to the smart home industry.

Most of the traditional smart home terminal based on the windows system. This design pattern is the limit of space and distance. Different from the traditional home terminal, the test of the application is based on Android system and allows user to have a remote access to the data of the smart home, which can acquire the real-time data and improve the user experience. What’s more, the application terminal can monitor the status of the smart home in real-time by mobile phone, which is convenient for the user to manage the smart home and increase the operating efficiency of smart home. The main purpose of this paper is to design a smart home application terminal for user to control house appliances remotely by wifi or data network.

The Design of Total System Structure

Brief Introduction of the Android System

Android is a mobile operating system (OS) led and developed by Goolge and the founding of the Open Handset Alliance, based on the Linux kernel and opened source code licenses. This platform mainly consists of four parts, which are operating system, middleware, user interface and application software. The system from the bottom to the upper application software does not exist any past the mobile industry innovation proprietary obstacles, which is known as the first mobile terminal to create a truly open and complete mobile software. The launch of Google Android in just two years, the market share has surpassed the Symbian system dominated more than ten years, to become the world's first intelligent mobile phone operating system. The Android released at the beginning of the openness and flexibility, which provides convenience for the development and application of smart home control terminal.
The Design of Overall Framework

As shown in Fig. 1, the overall framework of this system mainly consists of three parts. The middle of the intelligent gateway controller is the control core of the smart home. The internal structure of it is mainly composed of various modules, which is ARM processor module, 3/4G network module, Wifi module based on 802.11b/g/n protocol, ZigBee module with a short distance and low power consumption, memory module and variety of serial port, bus, input and output modules, etc. The control instruction of the intelligent gateway controller is sent out by the Android client through 3/4G or Wifi module. Switching equipment in the next level is directly controlled by the intelligent gateway controller, which includes Infrared control transponder, intelligent wireless outlet, intelligent wireless switch, etc. After receiving the signal from the intelligent gateway controller, the forwarding device performs the corresponding actions, and then achieves the purpose of controlling the household electrical appliances. In addition, some terminal devices such as terminal security, environmental monitoring, control terminal can be directly controlled by the intelligent gateway controller and monitored real-time safety condition of the home environment. The last level is a variety of household appliances controlled by smart home terminal, such as TV, air conditioner, lights, audio, water heater, electric cooker, etc. These appliances receive instructions from the gateway controller and achieve the corresponding function.

![Figure 1. Block Diagram of intelligent home.](image)

The Design of Software Structure

This terminal control system of smart home is based on Android platform. The software design is mainly to study how to develop the Android application client on the Android smart phone.

Development Tools

The majority of Android developers are using IDE "Eclipse" to develop the Android application client. Eclipse is an integrated development environment (IDE) in computer programming. It contains a base workspace and an extensible plug-in system for customizing the environment. Eclipse is written mostly in Java and its primary use is for developing Java applications, but it may also be used to develop applications in other programming languages through the use of a variety of plugins. Development environments include the Eclipse Java development tools (JDT) for Java and Scala, Eclipse CDT for C/C++ and Eclipse PDT for PHP, among others.

The initial codebase originated from IBM VisualAge. The Eclipse software development kit (SDK), which includes the Java development tools, is meant for Java developers. Eclipse SDK is free and open-source software. Users can extend its abilities by installing plug-ins written for the Eclipse Platform, such as development toolkits for other programming languages.
**Application Framework**

The application framework of smart home client is composed of three parts, which is User interface, Socket communication and SQLite database. Java main program uses a variety of components of the Android system in order to achieve their function, such as Activity, ActivityGroup, BroadcastReceive, Service, Content Provider, etc. The main xml program (activity_main.xml) adopts the most common LinearLayout. After installing the Android client successfully, the user only needs click on the App picture with your finger. Then the application will automatically enter the identity verification interface after 2 seconds of welcome picture. Only after inputting the correct account and password, can the user enter the main control interface. Finally, the user clicks on the corresponding button to achieve the purpose of controlling household appliances. Detailed design flow chart is shown in Fig. 2.

![Flowchart of Client](image)

**Client Function Introduction**

The client will enter the login interface after the user click on the app. The user need to register a account when they use this application firstly. Then, the client will enter the user interface after the user input their account and password. The user interface mainly includes four sub-pages, such as Home page, State, Setting and Exit. These four buttons are located at the bottom of the client interface. Home page is the main control interface of whole client, which displays the corresponding buttons of all of household appliances. For example, the biggest button of Home page is “Air conditioner”. The user can see the real-time temperature of house when open the home page. The user can adjust temperature, humidity and wind speed mode after click on this button. Operation method of the rest of buttons are similar to the air conditioner. The second page in the user interface is "state", and this page displays the real time status of household appliances, such as the door, window, light, air conditioning switch state of all the rooms. When not at home, the user can view and control remotely electric appliances. Meanwhile, this can avoid waste of resources and the occurrence of dangerous situations. The third page in the user interface is “Setting”. The main functions have managing account, adding electric appliances, adjusting brightness and replacing theme, etc. The client interface is shown in Fig. 3.
SQLite Database

The SQLite database used by the smart home client is a lightweight relational database built in the Android system, which is fast in operation, less occupancy and particularly suitable for mobile devices. SQLite is a popular choice as embedded database software for local/client storage in application software. SQLite not only supports standard SQL syntax, but also follows the “ACID”. The “ACID” stands for Atomicity, Consistency, Isolation and Durability. In addition, SQLite also supports NULL, INTEGER, REAL, TEXT and BLOB and other data types. Android system specially provides an abstract helper class SQLiteOpenHelper. Developer can use the two methods onCreate () and onUpgrade () in the SQLiteOpenHelper to create and upgrade their own database. At the same time, they can use the CRUD method in the SQLiteDatabase to operate own database. The “CRUD” stands for Create, Retrieve, Update and Delete.

Socket Communication

In order to achieve the purpose of controlling appliances, the client needs to communicate with all of the electric appliances. This paper uses the network application programming interface that Android system provides, using the ServerSocket and Socket method to create the TCP/IP protocol and completing communication between client and server by OutputStream and InputStream methods. A network socket is an endpoint of an inter-process communication across a computer network, which provides a port for communication with outside. The server creates one socket for client, and the socket shares the same local socket address from the point of view of the TCP server, and have a different remote address for client. By building socket connection, the Socket can establish a channel to transfer data for either side. The main features of Socket communication are low data loss rate, simple and easy to transplant. The process of Socket communication is shown in Fig. 4.

Figure 3. The client interface.
The server first declares a ServerSocket object and specifies the port number, and then calls the “accept()” method of ServerSocket to receive data from the client. The “accept()” method is in a jam state when no data is received. The key code is “Socketsocket = serversocket.accept()”. Once the data is received, the received data is read by “InputStream”. The client creates a Socket object and specify the IP address and port number of the server. The key code is “Socketsocket = newSocket("192.168.10.xxx",8080)”. The client reads data the server sends from “InputStream”. The key code is “OutputStreamoutputstream = socket.getOutputStream()”. Finally, the data written to the OutputStream can be transmitted to the TCP protocol to transfer socket data.

Conclusions

The smart home application client this paper introduces is based on the most popular Android system. The users only need to use Android smart phone or tablet PC in the major application market download and install the application package and don’t need to purchase other wireless terminal control equipment. After runs the client, the user can use GSM or Wifi to connect and control with a variety of electrical equipment remotely. This way is good portability and extension, low hardware cost and easy to spread, which is necessary to welcome to arrival of the Internet of things in the future. The client also need to add other functions in the subsequent development process. For example, the search for the specified connection device, a push-button to start and shut down the appliances, cooperation with more enterprises of smart home to make it compatible more appliances, etc.

References


