

# Research on energy-saving management and control of stadiums & gymnasiums based on Android SHD

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**Abstract.** As people pay more attention to sports, the degree of participation is getting higher and higher, the large and comprehensive gymnasiums are sprung up everywhere in the country. Different from the small gymnasium, modern large-scale gym is more powerful, and the control ability is more intelligent and humane, but there are still some inadequate. For example, the control is too centralized and regardless of flexibility. Based on this, this study proposed the use of Android SHD (smart handheld device) as a mobile terminal to match with the server work, so as to further improve the system functions. This study is based on the bus of the gym intelligent lighting control system, combined with wireless technology, to establish handheld devices and server communications, to achieve the indirect control of the gym lighting equipment through the two instruction interaction. The main work of this study is to select the communication protocol, establish communication, collect the command set and design Android SHD interface and so on. Through this study, we achieve the communication between client and server, and also set a more detailed and comprehensive function for client system, and then improve the original gymnasium intelligent lighting control system functions through Android SHD with the work of the server. The energy-saving management has a great practical significance.

**Key words.** Android, SHD, gymnasium, low frequency, energy-saving management.

## 1. Introduction

As people pay more attention to sports, the degree of participation is getting higher and higher, the large and comprehensive gymnasiums are sprung up everywhere in the country. Different from the small gymnasium, modern large-scale gym is more powerful, and the control ability is more intelligent and humane. It not only provides basic sports venues for sports activities, but also can host conferences, cultural activities and exhibitions, greatly improve the comprehensive utilization of the stadium and economic usefulness. Meanwhile, it offers a more comfortable and modern place for people. Lighting, as an important manifestation of stadium function, is an important part of the stadium design [1]. At the same time, when

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broadcasting the event, it is asked to show clear and comprehensive pictures for the television audience. And in order to achieve the above requirements, the stadium lighting should be ensured appropriate in vertical and uniform illumination, and the color, temperature, color rendering index, three-dimensional all need to achieve the standard parameter [2].

The gymnasium electric energy saving control system of this research is based on the CAN bus technology, to establish the entire communication used for gymnasium lighting, take the embedded web server as the entire intelligent lighting system control center. The user can achieve a variety of gymnasium lighting control through the image of the page in the developed server [3].

This study aims at the lack of intelligent lighting control system in modern gymnasium. This study puts forward the idea of central controller through the cooperation of mobile terminal. As Android development platform has a wealth of hardware options and a strong software framework support, so Android SHD has a wide application. Therefore, this study selects Android SHD as a mobile terminal, with the central controller to work, so as to further improve the gym energy control management research.

## 2. Basic communication experiment

### 2.1. *The research of Android-based application*

Before the establishment of the client and server communication, we need to build Android development platform, it includes JJDK, SDK, eclipse plug-in, and ADT plug-in. After successfully installing the above tools, you can use the AVD to develop Android application. First, we need to start Eclipse and select "File" item, then select "New", and then select "Android Application Project".

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We need to respectively type the appropriate name on Application name, Project Name, and Package. Usually, it should be noted that Application Name and Project Name use capital letters, Package Name use lowercase letters, and the choose of SDK version according to objective conditions and practical needs Select, when we select "Finish", then a new project was born [4].

After the successful creation of Android AVD, we can test program in Android AVD, this study only created a simple TextView, Button control, and separately set their value: Hollow World, Hollow Android Activity and Hollow Android. When debugging, we select "Run" option in the menu at the top of the Eclipse main interface, in turn select "Run As", "Android Application" option. The first time it needs a long time when you start the simulator, and wait a while before the program operates successfully.

### ***2.2. Single thread Socket communication***

Single thread Socket communication is client software development. Through the learning for TCP protocol and Socket communication programming, we can achieve the basic communication and simulation between client and server programmed on the Android platform, which means the communication between mobile phone and computer-side. As the program needs to be networked, so the network privilege of system must have done before network permissions, otherwise the system will be error, so in the initial of program creation, we need to add code in Android Manifest.xml file to support the normal network access.

### ***2.3. Multithread Socket communication***

The use of multi-threaded Socket programming: there is a problem for single-threaded Socket Programming. We need to deal with the accept operation and data writhing and reading after the establishment of Socket with different threads [5]. A single thread also can deal with this problem. For the connection request of each client, after the production of Socket, the server will generate a single thread to preserve the Socket and communicate with customer, so as to improve the efficiency of the program to customers. After the end of a client communication, Socket will exit, and the thread also will withdraw [6]. It also can make a further development on reading and writing thread, so that read and write operations can be processed in parallel; client processing is similar.

## **3. System design**

### ***3.1. Layout of system summary***

Based on the CAN bus control of gym intelligent lighting system, this study aims to improve the macro-function of gym intelligent lighting system through the implementation of Android SHD and server communications.

From the structure of the system, we can see that the system adopts the client/server structure, and has a good human-computer interaction performance. As the only server in system, the central controller server is the data aggregation in the entire system, and it is responsible for information collection and storage of lighting equipment. As a client, Android SHD can provide a good user interface so that users can control the gym lighting system flexibly through Andrews SHD.

### ***3.2. Interfacial design of Android client***

#### **(1) User login interface**

The identity of software user is divided according to the different needs for different groups in the intelligent lighting control system, the software users are divided into control and management personnel, maintenance personnel and ordinary audience. The user name and password of audience is empty, so we can login directly.

When the user logs in, the client will pass the user name and password to the server through Socket communication, and then the server will encrypt the data and store it in server within an existing user name through MD5 hash operation after receiving the data [7–8]. Different users select different options to log in different control systems, and they have different functional privileges. The related registration process as shown in Fig. 1.

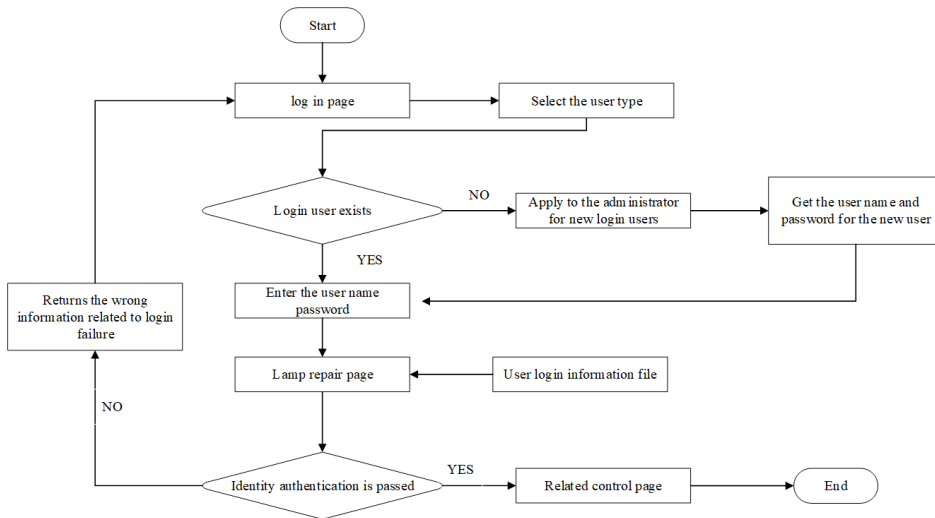


Fig. 1. Login authentication flow chart

The drop-down list shows the option entry for user's type in Login processing. When you click this option, it will pop-up four options like control personnel, maintenance personnel, professionals and system administrator.

#### (2) Control interface design for control personnel

According to the diversity of the function of large-scale gymnasium, the login main interface of system control personnel is divided into emergency lighting control, weather query and scenario mode selection. The flow chart shown in Fig. 2.

#### (3) Control interface design of maintenance personnel

Because the maintenance staff is only responsible for the maintenance of venues lighting equipment, so the system only set two simple scene mode such as the lamp full open and all closed mode, while providing the query of lamp life in order to simplify the maintenance work. In specific maintenance, the maintenance personnel firstly select the specific venue number, and click on the specific lighting options, then we can see the lamp life.

#### (4) User interface design for expert

Expert users can query the working smart relay combination for specific scenario and set connection with client server through the Socket communication. The client will show the display information through the List View platform. The using method is mentioned in the above, so here is not go into details. At the same time, the expert user can edit the profile, and pass the modified information to the server,

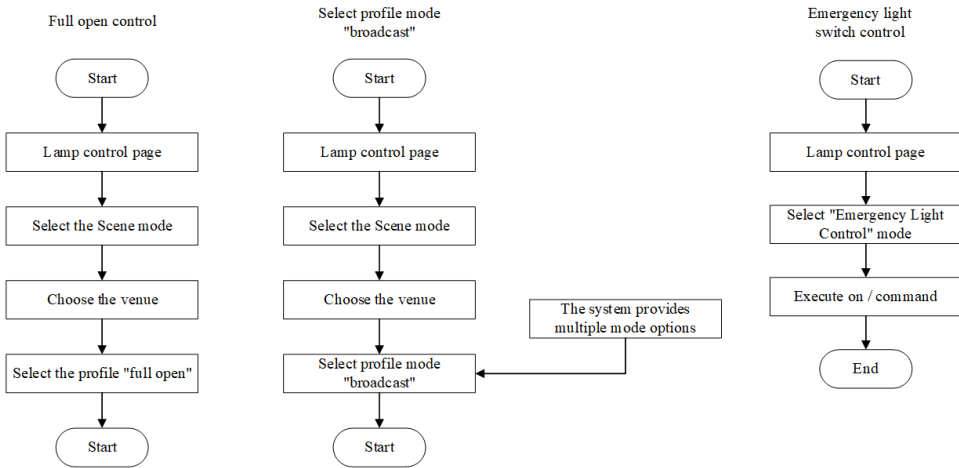


Fig. 2. Control module flow chart

then coverage the server-side data, so as to achieve the purpose of modification. Expert user clicks on the audience mode, and the server diary record the client's request, the flow chart as shown in Fig. 3.

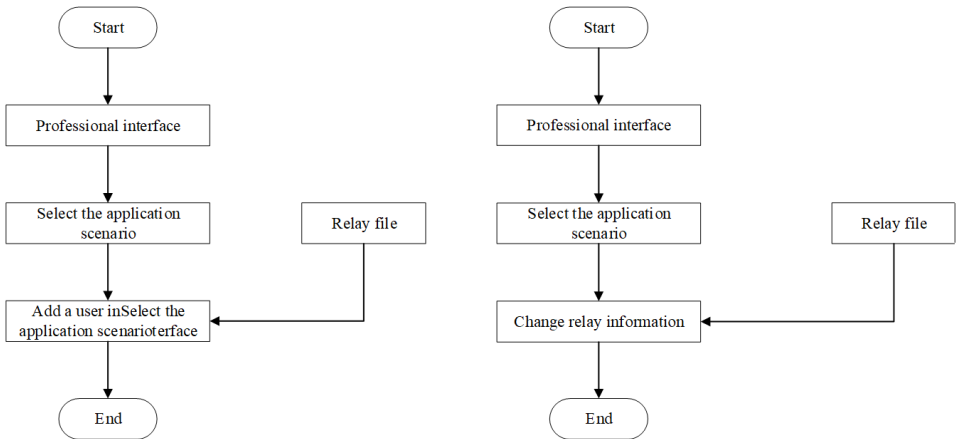


Fig. 3. Flow chart of scene editor

(5) System administrator interface design

If the user information does not exist, you need to apply a new number for the administrator. After passing application, the administrator user login system through the system management staff number, and fill in user type, user name, password and other information in the new user page. The server information file is updated after the success of new user added, and the flow chart of new user is shown in Fig. 4.

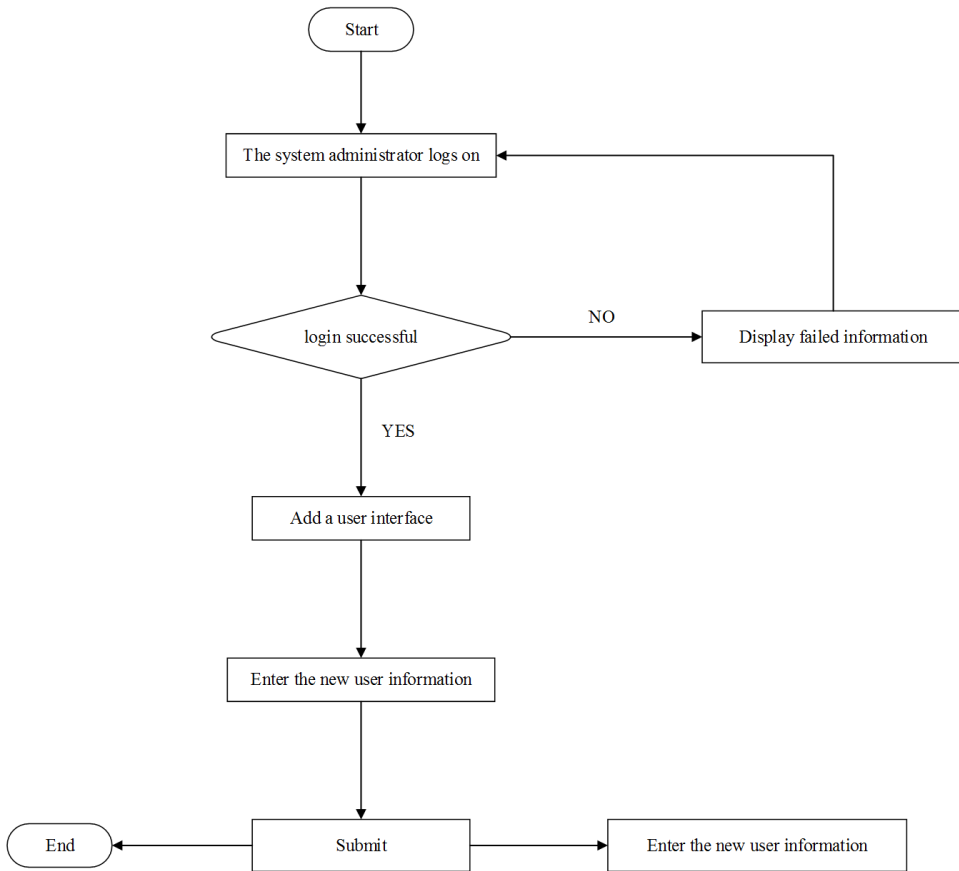


Fig. 4. Add user flow chart

## 4. Conclusion

In this paper, through the establishment of single-threaded client and server basic communication, we explore the multi-thread client and service-oriented basic communication technology. Through the overall framework of the system and functional analysis, we set command set of client and server according to its function. The system users are divided into control management, maintenance personnel, professionals and system management staff. Developing the software in the platform, we can achieve the control for most of lighting on the platform, and the simple and intuitive interface design brings some good feelings for user to experience the application. Based on the gym power energy management of Android SHD, management control for the stadium will be more centralized and efficient.

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