Android-Based Intelligent Farmer Power Management System

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Abstract. Intelligent farmer power management system software is available for intelligent, small, single-user rural farmer systems. It is mainly used for real-time monitoring, data analysis and comprehensive coordinated control of solar energy, farm household consumption and energy storage units. The traditional farmer power management system is based on the Internet B/S structure and is developed using a standard J2EE platform. It requires an independent computer, software server, and database server to support operation and access. Based on the Android operating system, middleware and key applications, the intelligent farmer power management system software platform is based on the basic business of intelligent farmer power system consumption management, and solves the needs of farmers for real-time and historical data consumption. The easy-to-carry mobile phone smart terminal device overcomes the drawbacks that must be accessed by a computer, and can be conveniently and flexibly used for login, data access and remote control at any time, and is an important means for intelligent agriculture and intelligent farmer business promotion.

1. Introduction

Android is an open source operating system based on embedded Linux developed by Google Inc., which is an open source mobile phone software platform that meets the needs of portable mobile devices, including the operating system, user interface and applications. The Android kernel is modified from the standard Linux kernel, so it integrates the various advantages of the Linux kernel. While retaining the main structure of the standard Linux kernel, Android has modified the memory management, file system, inter-process communication and power management in accordance with the needs of mobile devices, adding corresponding drivers and some necessary features.

Intelligent farmer is the main executive part of intelligent agriculture and an integral part of the intelligent agricultural economy. Intelligent farmers are the products of new power generation technology, internet+, and other technological developments. They include the distributed power, storage batteries, mobile internet, smart phone control and management system.

The intelligent farmer power management APP provides a B/S structure system for real-time monitoring of distributed power, user consumption, environmental parameters, energy storage units, statistical analysis of data, comprehensive coordinated control and analysis. For users who use a PC, they can access the system remotely using a browser. For users who use Android phones, you can choose to install the Android client program so that you can access the system remotely from your phone.

By developing applications on smart phones and tablet devices, the features and advantages of mobile devices can be fully realized, enabling users to access data of remote servers directly on mobile devices, improving work efficiency and changing the management system used in the past. These
applications can provide users with a more friendly interface environment, so that users can timely understand the operation of the field equipment, reduce the operational risk and improve the management level.

2. System platform

2.1 Hardware
According to the comprehensive comparison of the operator's working environment, screen display content and mobile phone standby time, the client software uses Huawei's glory mobile phone as the hardware platform, which is a frequency of 4*2.36GHz+4*1.7GHz processor. The Android smartphone enables operators to smoothly access data of remote servers in various working environments, while avoiding repeated hardware development, improving development efficiency and saving development costs.

2.2 Software
According to design and develop the application program of the intelligent farmer client software, first select the hardware platform, and then build a software development environment based on this. The application software development environment is built on the Windows XP operating system. The specific construction method is as follows:

2.2.1 First need to install Java Development Kit, and configure the environment variables;
2.2.2 Secondly download and install the development tools;
2.2.3 Install the android Tools plugin;
2.2.4 Finally download and install the Google Android SDK.

3. Android and J2EE integration
The remote server management system is developed using the standard J2EE platform. The system uses a commercial related database for data management. The Android client interacts with the controller component of the server program over the network. The entire application is well modeled and the entire project is extremely scalable and maintainable.

The general trend in the development of Android systems is to integrate with traditional server application systems. Because the hardware resources of mobile phones are limited after all: the computing power is limited, and the ability to store data is limited, so Android applications are more suitable as clients for the entire application. The mobile phone is convenient to carry, can run the application anytime and anywhere, and can access the network at any time, and interact with the server application through the network to obtain the data information of the server.

The intelligent farmer power management system software is not a simple mobile phone or server-based small application, but an application that integrates Android with traditional server applications. In this application, the server program still maintains a good application architecture, while the client side maintains a good application architecture.

The server side of the entire application is a complete J2EE project. The server side uses interface display, logic and control, and the data acquisition has several layers of architecture. The Android client application is responsible for interacting with the logical control layer of the server. The Android application uses the Apache class object to send a request to the logical control layer of the server. The remote application server usually has a separate IP address, and the client application provides the IP address and the server according to the IP address. The port number accesses and obtains the response of the server. The server responds with a specific data format, which enables more effective data interaction. Some of the code is as follows:
Public HttpClient H = new DefaultHttpClient();
Public static String postRequest(String url, Map<String, String> rawParams)
   Throws Exception {
    HttpPost p = new HttpPost(url);
    you can encapsulate the passed parameters
    List<NameValuePair> params =
    new ArrayList<NameValuePair>();
    For (String key : rawParams.keySet())
        { params.add(new BasicNameValuePair(key, rawParams.get(key)));
        }
    post.setEntity(new UrlEncodedFormEntity(params, "gbk"));
    HttpResponse httpResponse = httpClient.execute(post);
    // If the server returns a response
    If(httpResponse.getStatusLine().getStatusCode() == 200) {
    // Get the server response string
    String result = EntityUtils.toString(httpResponse.getEntity());
    Return result;
    }
    return null;}

This enables communication between the Android system client application and the server-side application. As shown in Figure 1,

4. Android and J2EE integration
The intelligent farmer is a system consisting of load and distributed power. The internal energy is responsible for the conversion of energy. Compared with the external performance, it is a single independent controlled unit that can meet the user's requirements for power consumption.

Smart farmers usually consist of inverters and their controllers, multi-function smart meters, small wind turbines, photovoltaic power generation units and storage batteries, as shown in picture 2,
For intelligent farmer, it can maintain local voltage stability, increase local reliability, and reduce losses through self-use. It can improve the utilization efficiency of electric energy and meet the specific needs of intelligent farmers. The intelligent farmer itself is a controllable unit, which is affected by the weather and the like, and on the other hand can be scheduled to a certain extent, which also provides flexibility. The intelligent farmer energy management system provides fast data analysis and decision-making methods, monitoring methods and comprehensive control methods for intelligent farmers based on the data information of remote equipment and user electricity consumption information.

5. Main function
The intelligent farmer power management system software mainly provides real-time data viewing including remote distributed power and load, power curve analysis, power composition statistics, data comprehensive analysis and remote control functions, and can also view program version information of the client software.

By clicking the icon of the software in the Android platform mobile phone, you can directly enter the software login interface, input the correct user account, user password, send the request to the remote server through the Apache class object, and enter the function selection main menu after successful verification by the server. As shown in Figure 3.

5.1 Data monitor
The real-time data display implements real-time monitoring of the status of remote devices and users. It includes data on voltage, current and power of fans, photovoltaic units and energy storage batteries; load voltage, current and power. By clicking the summon real-time data
button in the interface, the client software sends the command to the remote server. The server-side management program writes a command to the system database. The system's front-end machine reads and interprets the command, and then according to the command, read remote data information and return to the client software. By configuring the XML file, the Android platform displays the returned data in different categories in the `<TeView/>` and `<LiView/>` tags provided by Android, and finally displays them on the main interface of the program.

5.2 Power curve
The intelligent farmer power management software draws a graph on the Android platform, including the photovoltaic unit active power curve, grid input active power curve, user load consumption power curve, user inverter grid power curve, energy storage battery power curve. As shown in Figure 4,

![Fig. 4. Power Curve](image)

By analyzing the curve data, the user load consumption should satisfy the following balance equation:

\[
W = W_g + W_w + W_s + W_b
\]

where:

- \(W\) represents the user's power consumption,
- \(W_g\) represents the grid energy,
- \(W_s\) represents the photovoltaic unit output energy,
- \(W_w\) represents the fan output energy.

According to the energy data of photovoltaic and wind power generation units combined with meteorological data conditions, it provides scientific and reasonable predictions for the energy distribution of photovoltaic power generation and wind power generation by viewing data timely through intelligent farmer management software. When there are plenty of new energy sources, farmers can choose new energy sources to supply electricity.

5.3 Power statistics
The electricity statistics can show the total active power input to the grid, the total active power of the inverter, the total active power of the load and the power generation of the photovoltaic unit.

5.4 Data analysis
The farmer load type can be divided into important load and general load. According to the power situation of the power load of each level displayed by the client software and the power consumption status of each period, the power cost objective function of each stage of the load is divided into time periods.
MinCo = \sum_{i=1}^{T} U_i (ZL * Di + YL * Di)

Co represents the cost of electricity for the user, i represents the electricity consumption period of the peak flat valley from 1 to T, Ui represents the electricity price per period, ZL, YL represents the power of the important load and the general load, and Di represents the load. The length of time during which time i is used. This provides a good analytical strategy for users to use electricity and electricity economically.

The objective function satisfies the following unequal constraints:

\[ 0 \leq ZL \leq P_{max,ZL}, \quad 0 \leq YL \leq P_{max,YL} \]

\( P_{max,ZL}, P_{max,YL} \) represent the upper limit of the power of the important load and the general load shall not exceed the upper limit.

6. Conclusion
This paper introduces the development environment of the Android based application and communication with the server. It analyzes and implements the real-time data monitor, environmental data query, energy consumption data analysis and remote control of the intelligent farmer. The open Android platform enables the software to have a good expansion space, and display information fast, conveniently and flexibly. Farmer can timely discover problems in the operation of photovoltaic units, batteries, etc., and reduce security risks. However, due to the poor signal limitations of mobile phones in some remote areas, Android-based client software may have a certain degree of blocking access to remote servers. As the country invests heavily in communication networks, the communication network will continue to improve. It is foreseen that the client software developed for mobile phones based on the Android platform will be widely popular.

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