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# Smart Cabinet Panel Based Load Management Service System for Integrated Ecosystems Management

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**Abstract.** As the Smart grid is intelligent power grid, combining information Technology to the existing power grid. Electricity suppliers and consumers exchange real-time information to two-way and is a next-generation power grid to optimize energy efficiency. This paper suggests the implementation of load management application system in energy management service environment.

**Keywords:** energy management, load management, smart socket, energy

## 1. Introduction

Load leveling is method for reducing the large fluctuations that occur in electricity demand, for example by storing excess electricity during periods of low demand for use during periods of high demand. The load management system compares total power consumption and quarterly power consumption of digital meter centering on cabinet panel and sends the "interruption" command to the sockets mounted to the power source in the order of priority when the power consumption exceeds the quarterly limit in order to control power which is not urgently required or not required at all [1]-[3].

There are similar systems such as the power monitoring system which detects the power currently consumed by the user as well as the power consumed during a certain period to induce better power conservation, the power saving system which minimizes power consumption for unnecessary use by reserving the consumption of power by home appliances such as the management of power consumption through the out mode or ordinary mode depending on whether the user is inside or outside the building, the added service system minimizes unnecessary use of the electricity in the time zone when the demand of power is low by responding to user demand when the flexible rate system which changes rates for different time zones would be applied, and the temporary system for selling the power generated through solar power generation equipment to the power companies [3]-[5].

## 2. Overview of Load Management System

The load management system compares total power consumption and quarterly power consumption of digital meter centering on cabinet panel and sends the "interruption" command to the sockets mounted to the power source in the order of priority when the power consumption exceeds the quarterly limit in order to control power which is not urgently required or not required at all. There are similar systems such as the power monitoring system which detects the power currently consumed by the user as well as the power consumed during a certain period to induce better power conservation, the power saving system which minimizes power consumption for unnecessary use by reserving the consumption of power by home appliances such as the management of power consumption through the out mode or ordinary mode depending on whether the user is inside or outside the building, the added service system minimizes unnecessary use of the electricity in the time zone when the demand of power is low by responding to user

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demand when the flexible rate system which changes rates for different time zones would be applied, and the temporary system for selling the power generated through solar power generation equipment to the power companies [6]. Various systems are combined to form the load management system as in Figure 1. The load management system can be generally divided into 4 units: smart cabinet panel, smart socket, data receiver, and load management program as in Figure 1. The smart socket and smart cabinet panel send and receive data through Zigbee communication as in Figure 1 and the data receiver and load management program, UART (Universal Asynchronous Receiver/Transmitter) communication to monitor the information coming from smart socket and smart cabinet panel and control the device. The load management program is composed of main monitoring and control, device information management, power information analysis, accident information analysis, administrator control, XML environment setting, and database as in Table 1.

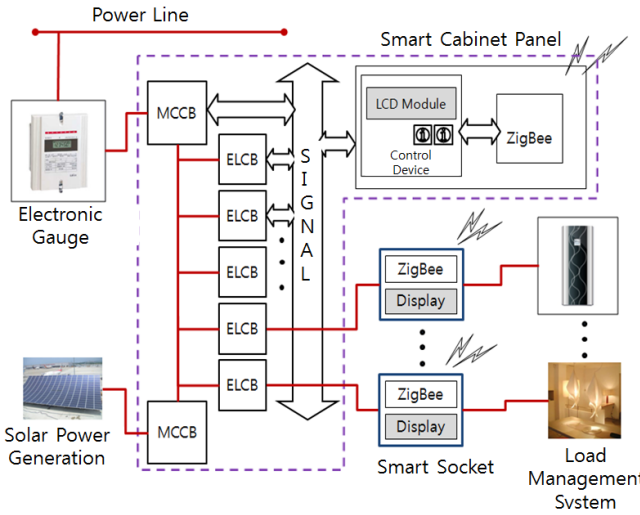


Fig. 1: System conceptual diagram of LMS.

Table 1: Component of Load Management System.

| **Load Management Program** | |
|---|---|
| Components | Description |
| Main Monitoring and Control | Monitors the device related information in real time and controls the device through data receiver using UART communication |
| Device Information Analysis | Manages the meta information of smart cabinet panel and socket device |
| Power Information Analysis | Searches for power information saved to the database, displays it in graphs |
| Accident Information Analysis | Searches for smart cabinet panel accident information and displays the status in text |
| Administrator Control | Synchronizes the time information of the cabinet panel and debugs communication status of the device |
| XML Environment Setting | Sets whether the program should start automatically |
| Database | Used to record and analyze the meta information, power information, and accident information of the device |

Data receiver is classified into UART information processing and Zigbee information processing as in Table 2.

Table 2: Component of Data Receiver.

| Data Receiver | |
|---|---|
| Processing Method | Description |
| UART Information Processing | Sends the information the user requested with the load management program through load management UART communication to the smart cabinet panel through Zigbee communication, and Zigbee module processes the information received and sends it to the load management program |
| Zigbee Information Processing | Used for the communication and data processing with smart cabinet panel |

Smart cabinet panel is generally composed of CANTUS module and LM2455-SE module as in Table 3.

Table 3: Component of Smart Cabinet Panel.

| Smart Cabinet Panel | |
|---|---|
| Components | Description |
| CANTUS Module | Divided into device control and monitoring, recording and processing of device information, and UART information processing |
| LM2455-SE Module | Divided into UART information processing and Zigbee information processing, and UART processing is in charge of the communication with CANTUS module and Zigbee information processing is in charge of the communication with data receiver and smart socket |

Smart socket is classified into the control and monitoring of device and Zigbee information processing. The information transmitted between such devices can be seen as in Fig. 1 [8].

## 3. Implementation of Load Management Application System

Load management application program allows the user to control and monitor each device. The interface for load management application program is shown in Fig. 2 [7], [8].


Fig. 2: Load Management Application Program Interface.

The screen for load management application program is generally divided into the device connection information area (A) and device control and monitoring area (B). In Area A, set the load management program and data receiver information and make connection. Area B is basically disabled. When the meta-information of smart cabinet panel and smart socket is registered through device information management for device connection, the data receiver is connected, and the device connection in Area A succeeds, Area B will be activated. Area B is divided into the smart cabinet panel on the top and smart socket on the bottom. The right side of Area B is allocated for real time data monitoring and control. The previously stored information can be monitored and analyzed through the accident information status and accumulated power status on the bottom left side of smart cabinet panel. In the smart socket area, sockets can be selected with the socket selection combo boxes on the top left for monitoring and control of the selected sockets.

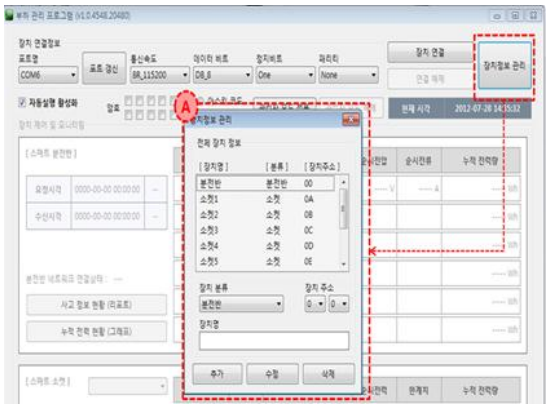

Fig. 3: Device information management display.

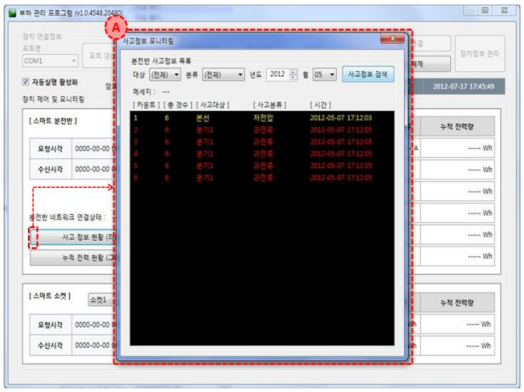

Fig. 4: Accident information monitoring display.

Click the Device Information Management on the top right side of the main monitoring screen to open the management screen. Device information management is shown in Area A. The top side of Area A shows the list of meta-information of all devices and the detailed information will be displayed when the corresponding device is selected. Manage the meta-information of the device by using "Add", "Edit", and "Delete" buttons on the bottom of the screen. The load management program can operate at least one cabinet panel device information is registered [6]-[8].

Click "Accident Information Status" button of the smart cabinet panel in the main screen to start "Accident Information Monitoring." "Accident Information Monitoring" is shown in Area A. Search for accident information by selecting "Subject", "Category", "Year", and "Month" options on the top and the search result will appear in the form of list of text on the bottom.

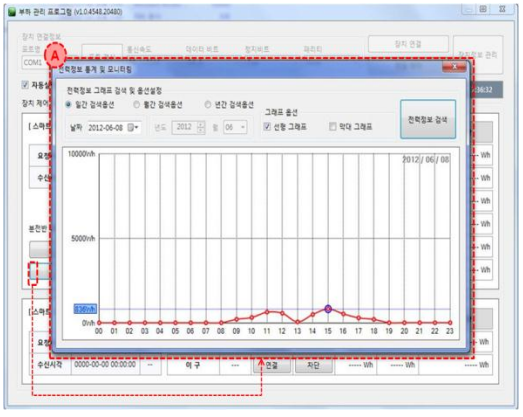

Fig. 5: Electricity information statistics and monitoring display.

Click the "Accumulated Power Consumption Status" button of the smart cabinet panel in the main screen to start "Power Information Statistics and Monitoring." "Power Information Statistics and Monitoring" is shown in Area A. Search for power information by selecting "Daily", "Monthly", or "Yearly" category on the top side of Area A and selecting the date. The result of search is displayed in the graph on the bottom of the screen and the data can be shown in different graphs through graph options.

## 4. Conclusion

As the Smart grid is intelligent power grid, combining information Technology to the existing power grid. Electricity suppliers and consumers exchange real-time information to two-way and is a next-generation power grid to optimize energy efficiency. This paper suggests the implementation of load management application system in energy management service environment [1]-[3].

In this paper, the load management system can be generally divided into 4 units: smart cabinet panel, smart socket, data receiver, and load management program. The smart socket and smart cabinet panel send and receive data through Zigbee communication and the data receiver and load management program, UART communication to monitor the information coming from smart socket and smart cabinet panel and control the device. The load management program is composed of main monitoring and control, device information management, power information analysis, accident information analysis, administrator control, XML environment setting, and database.

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