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Felix Pasila
Yusak Tanoto
Resmana Lim
Murtiyanto Santoso
Nemuel Daniel Pah
Editors

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Chapter 36
IP Based Module for Building Automation System

J.D. Irawan, S. Prasetio and S.A. Wibowo

Abstract Embedded systems technology has a lot of applications in the various fields of life to bring ease and comfort for humans. One kind of applications is in the development of modern buildings, where embedded systems are applied to the control system. Building Automation Systems (BAS) are often encountered in modern buildings today. They are responsible to automatically control the building appliances such as electrical equipments, fire alarms, security systems, and others. Conventionally, a smart home that can be controlled by an embedded system is connected to a central monitoring unit such as a computer. The system commonly employs RS232 or RS485 serial communication, so that the control activities cannot be carried out from a long distance. With the rapid technology development in the field of communication, many recent communication devices are practical and have a good performance. One of them is a device with the Android operating system that can access the internet, thus it has a significant role in simplifying the management of smart homes. This research proposes the design of a smart home that can conserve energy by turning off unneeded electrical appliances, detect disorders such as flood, fire, and theft, and also serve as an early warning system through SMS Gateway. It can be monitored and controlled remotely over the Internet by an Android device.

Keywords Building automation system · IP based module · Smart house

36.1 Introduction

A lot of embedded systems technologies are applied in various fields of life to fulfill the human desire to live easily and comfortably. One example is the building of a house. Currently, building a house or modern building requires electronic control

J.D. Irawan (✉) · S. Prasetio · S.A. Wibowo
Informatics Engineering, National Institute of Technology, Malang, Indonesia
e-mail: joseph_dedy@yahoo.co.id

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tools. The Building Automation System (BAS) is often encountered in the construction of modern buildings [1].

BAS provides automatic control of the environmental conditions in buildings. BAS was begun from process automation to the heating, ventilation and air conditioning systems (HVAC) in large functional buildings. The ultimate goal is to save energy and reduce costs. However, this system can be developed and applied to a house to build a smart home that can monitor all conditions and manage all electrical appliances. Hence, even if the occupants are not in the house, they can still monitor and control it, and need not feel anxious.

This gave us the idea to design a smart home that can control the entire electrical loads inside the house; each point of loads can be monitored and even its activity scheduled. The system was designed based on TCP/IP and the main component is an embedded web server. The house is also equipped with an early warning system that will inform the occupants via SMS in case of fire or flood, as well as a theft detection system with cameras that can be monitored remotely over the internet using an Android device that can monitor and control all electrical appliances at home.

36.2 Related Works

36.2.1 Serial Communication

Serial data communication has the impression of being more complicated than parallel data communication, but serial data communication has a lot of advantages compared with parallel data communication, such as it requires only three wires (i.e., Tx, Rx, and Ground) to transmit information. In addition, the communication distance can also be increased further.

In the serial data communication, we can perform data communication using RS232 with a maximum distance of 10 meters, but data communication using RS486 can be carried out up to approximately 100 meters. Besides the advantage of a longer distance, communication using RS485 can be done with more than two terminals, in full duplex, and with high data accuracy [2]. Figure 36.1 below is an

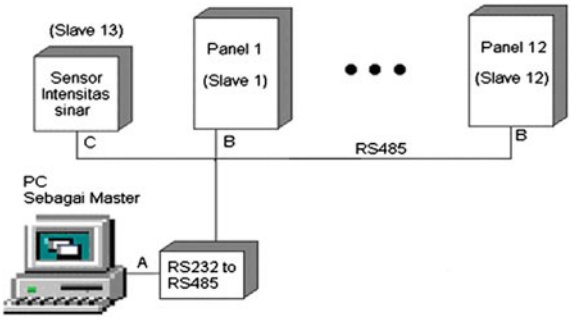

Fig. 36.1 Block diagram of building automation system using serial communication [2]

example of serial data communication using RS485 for monitoring and controlling a Building Automation System [3].

36.2.2 Monitoring and Controlling via Internet

With the advancement of Internet technology, which is considered a reliable communication, it is obvious that the Internet can be used as a medium for long-distance monitoring and controlling. Internet is expected to be a good medium because there are many available communication protocols on it with the ability to reduce errors during transmission.

Communication over the Internet can be used to monitor as well as control equipment located far away from the user easily and quickly, as can be seen in Figs. 36.2 and 36.3 below.

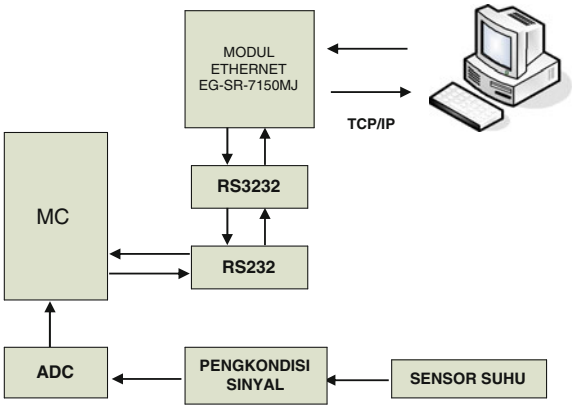

Fig. 36.2 Block diagram of temperature monitoring via web [4]

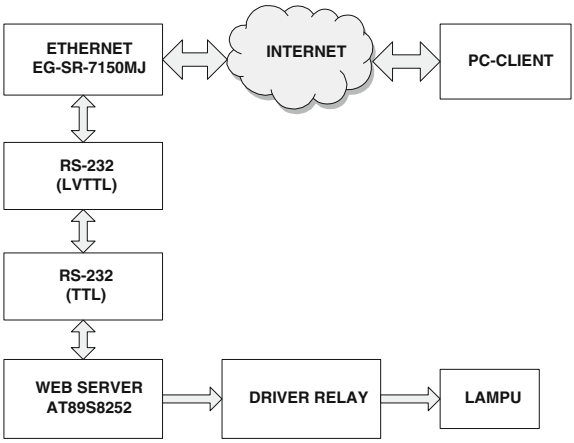

Fig. 36.3 Block diagram of controlling lights via web [5]

However, when a Personal Computer (PC) is used as a Web Server connected to the appliance so that it can be controlled over the Internet, the solution becomes non portable and requires a lot of power because the PC must be running continuously and should never be turned off. Therefore, for the purpose of portability and power efficiency, a small device can be created to replace the PC as a Web Server; the device can be used to, in this case, monitor and control lights remotely. Microcontrollers are used as a Web Server and equipped with Ethernet Module for connection to the Internet. The advantage of this system, compared to Web servers on the market, is the TCP/IP (Ganesh, 2008) embedded in the microcontroller as software, so that it becomes much more efficient, more compact, and cheaper since it does not require a PC to work as the Web Server. The use of microcontroller can be replaced with other control equipment such as PLC.

36.3 System Model

The system discussed in the related works has some shortcomings, mainly to meet the demanding need of online access over computer networks and the Internet.

To improve the performance of the system, this study proposed the design of building automation system, which is implemented as a Smart House, with embedded web server application as the main component. The proposed system can be accessed over the Internet by means of a device with Android operating system.

The system block diagram, as shown in Fig. 36.4, consists of several parts: embedded web server and switching panel, monitor unit, LAN, and internet proxy server [6].

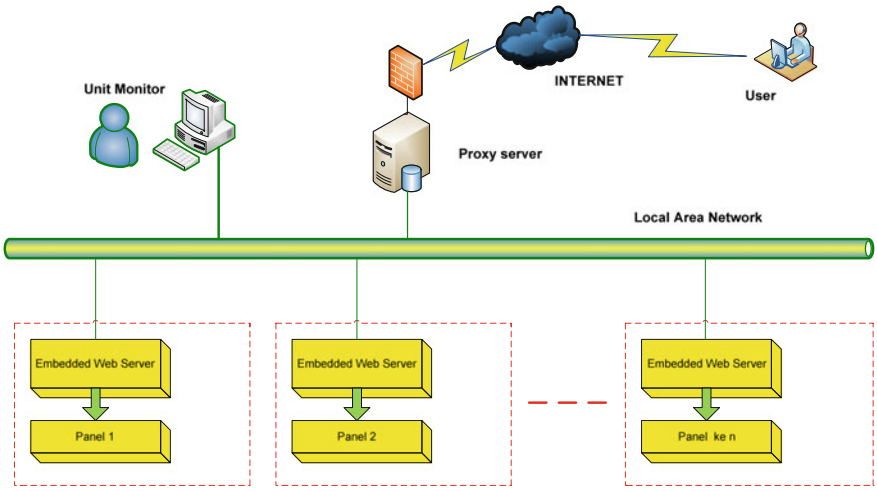

Fig. 36.4 System block diagram of the IP based module for smart houses

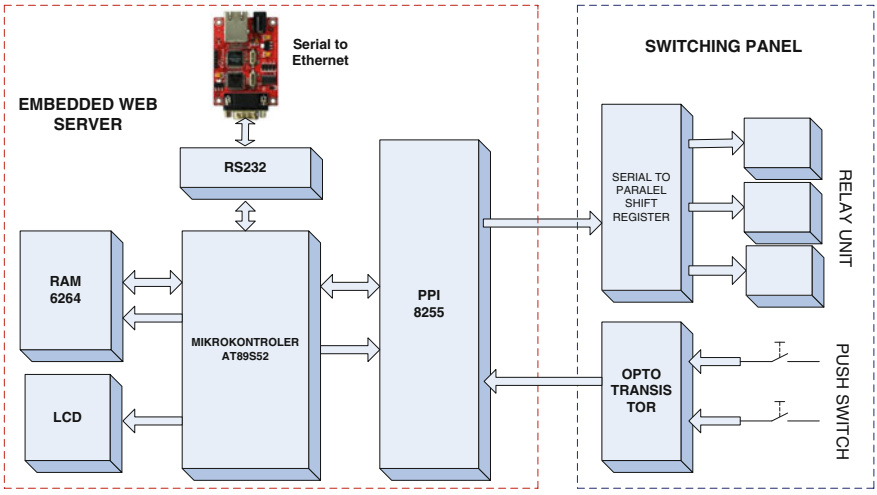

Fig. 36.5 IP based module and switching panel

The embedded Web Server module and the switching panel are shown in Fig. 36.5. The embedded web server is built using the microcontroller as the main component and is equipped with supporting components such as RAM, I/O, and serial to Ethernet converter unit.

The switching panel is a functional unit for termination between power load and BAS module. The main components are the optocoupler as a signal isolator and switching components in the form of push buttons and sensors as input/output relays.

Figure 36.6 indicates that initially the system reads the temperature, light intensity of the sensor, and relay status; the data are published on the Web so that the user can monitor the status of electronic equipment in the house. After that, the user can switch the light of the house by pressing the ON or OFF so that the condition of the relay will change according to the user's wish.

36.4 Results

As shown in Fig. 36.7, the temperatures of bedroom 1 and bedroom 2 can be monitored. The user can turn on or turn off the air conditioners by pressing the ON or OFF buttons on the application.

Other buttons can be used to turn on or turn off the lights in the house. When the button is pressed, the application will send the data to change the state of the lamp according to the user's demand.

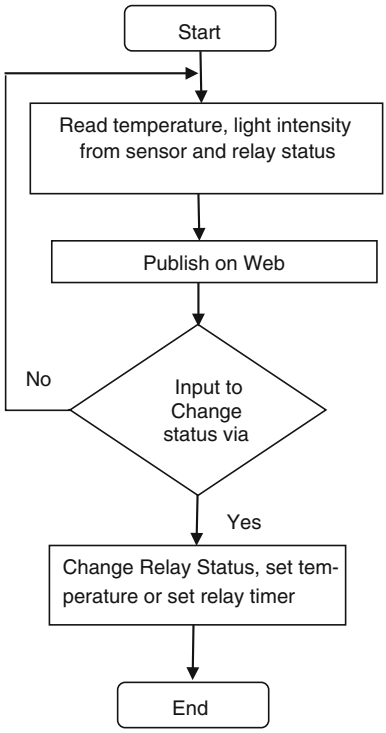

Fig. 36.6 System flowchart

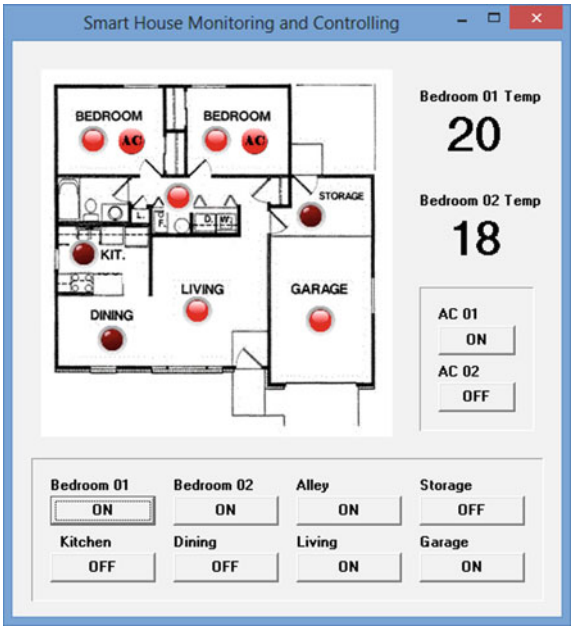

Fig. 36.7 Smart house monitoring and controlling

36.5 Conclusion

The IP Based Module for Building Automation System is very easy to implement because, by using the IP based module controlling unit, installation can be done quickly. Also, with the IP based program module, data communication becomes easier to do.

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